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TURCK

The Full Range For Pressure Sensors

A Global Leader in Industrial Automation

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2,000+ EXPERIENCED SALES REPRESENTATIVES

Pioneer in non-contact **sensing** technology

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Strategically placed manufacturing facilities in the **USA** with **28** GLOBAL SUBSIDIARIES

GLOBAL BUT LOCAL...

60 representations worldwide

Content

Pressure Sensing

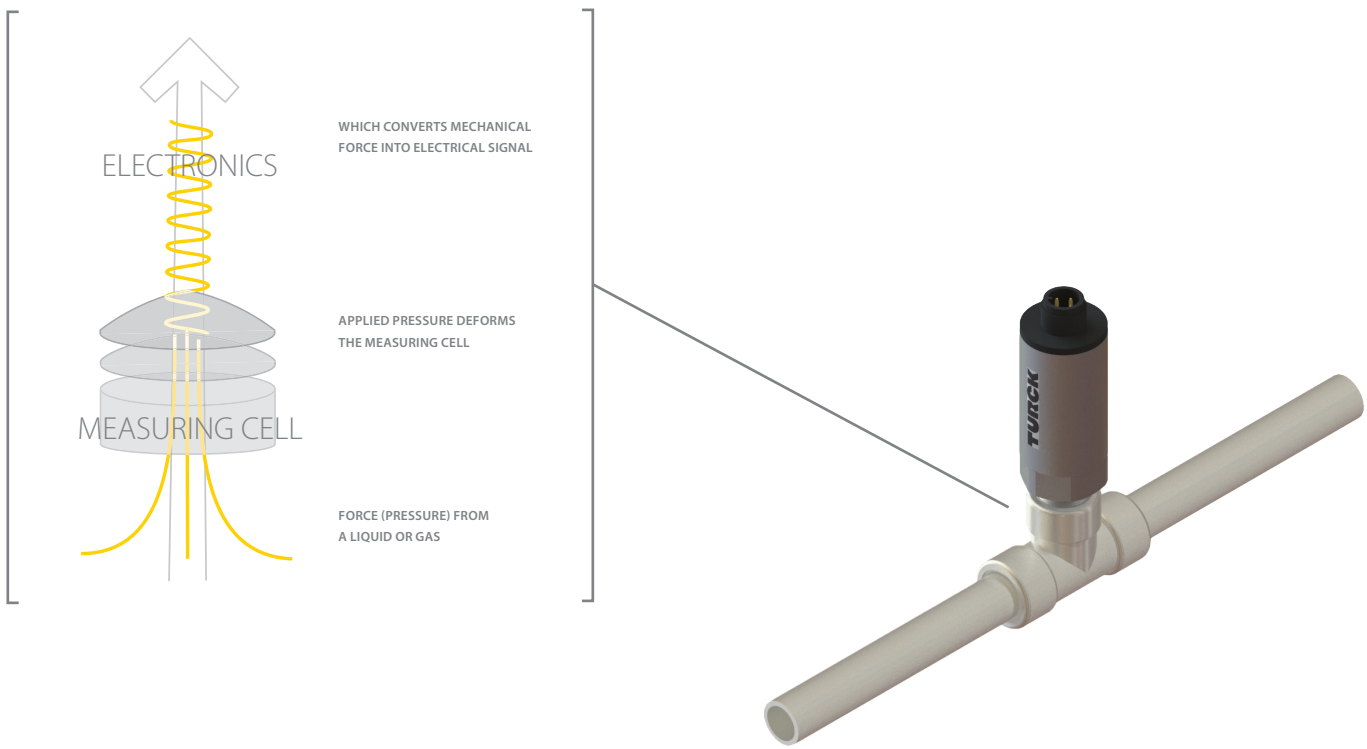

Fig. 1

Pressure is all around us. Most people don't think about it much, but it's something the manufacturing and industrial worlds deal with on a daily basis. A large portion of the machines out in industry utilize at least one form of fluid power.

Fluid power is a general term that can refer to gas or liquid. A gas would be defined as an air-like fluid substance which expands freely to fill any space available, irrespective of its quantity; a liquid is a substance that flows freely but is of constant volume, having a consistency like that of water or oil. Pneumatic systems utilize gases, while hydraulic systems utilize liquids.

Many fluid power systems, either hydraulic or pneumatic, have to be monitored for pressure. There are many ways to detect pressure, and the most common is a Bourdon tube gauge. Every gauge has the potential to be a pressure sensor. A pressure sensor has a measuring cell that converts (or transduces) the mechanical strain of the pressure applied and converts the force into an electrical signal (*Fig. 1*). Pressure in a pipe, hose, or duct applies force on the measuring cell of a sensor, causing a deflection which is measured by an electrical circuit. This measurement is then converted into a current or voltage output.

Pressure sensors can be used in many different types of applications, from pressure monitoring to level and flow detection. The latter sections of this guide go into further detail regarding the application considerations to be aware of when utilizing a pressure sensor.

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PS Series Programmable Pressure Sensors

The PS series pressure sensor combines a fully programmable sensor with a digital display for local indication of pressure. Designed with a rugged stainless steel housing, these sensors will perform in the most demanding applications.

- Fully programmable output, functionality, scaling, and display
- Rugged 303 stainless steel housing
- NPT, G (BSPP), and SAE-ORB process connections
- Optional rotatable housing
- Ranges up to 600 Bar
- IO-Link

Performance Data

Over Pressure	See data sheet
Burst Pressure	See data sheet
Programmable Output Type 2UPN	2X PNP/NPN N.O./N.C
Programmable Output Type LI2UPN	0 - 20 mA, 4 - 20 mA, 20 - 0 mA, 20 - 4 mA and 1X PNP/NPN N.O./N.C or 2X PNP/NPN N.O./N.C
Programmable Output Type LUUPN	0 - 10 V, 1 - 6 V, 0 - 5 V, 10 - 0 V, 6 - 1 V, 0 - 5 V and 1X PNP/NPN N.O./N.C or 2X PNP/NPN N.O./N.C
Analog Accuracy LHR (LI2UPN8X and LUUPN)	≤ ± 0.5% full scale
Programmable Analog Start Point (LI2UPN8X and LUUPN)	0 - 75% measuring range
Programmable Analog End Point (LI2UPN8X and LUUPN)	25 - 100% measuring range
Set Point Accuracy	± 0.5% full scale
Set Point Range	1 - 100% measuring range
Reset Point Range	0.5 - 99.5% measuring range
Set Point Hysteresis	± 0.5% full scale
Repeatability	≤ 0.5% measuring range
Temperature Coefficient Zero Point	≤ 0.15% of measuring range per 10 °C
Temperature Coefficient Span	≤ 0.15% of measuring range per 10 °C

Electrical Data

Operating Voltage	18 - 30 VDC
Current Consumption	≤ 50 mA
Voltage Drop	≤ 2 V
Analog Load (LI2UPN8X and LUUPN8X)	≤ 500 Ω
Switching Frequency	≤ 180 Hz
Response Time	< 3 ms
Short Circuit/Reverse Polarity Protection	Yes/Yes
IO-Link	Version 1.1

Environmental Data

Ambient Temperature	–40 to 70 °C
Storage Temperature	–40 to 80 °C
Medium Temperature	–40 to 85 °C
Housing Materials	303 stainless steel
Wetted Materials	303 stainless steel, FPM, AL_20_3 ceramic
Protection Type	IP 67/IP 69K
Shock Resistance	50 g per IEC 68-2-27
Vibration Resistance	20 g (9 - 2000 Hz) per IEC 68-2-6
LED Measuring Value	4 digit 7 segment display

Part Number Key

PS	010V	-	5	03	-	LI2UPN	8	X	-	H1141

Pressure Sensor

Pressure Range and Scale

0.25V = –0.25 to 0.25 Bar (–3.63 to 3.63 PSIG)
01VR = –1 to 0 Bar (–14.5 to 0 PSIG)
001R = 0 to 1 Bar (0 to 14.5 PSIG)
001V = –1 to 1 Bar (–14.5 to 14.5 PSIG)
003V = –1 to 3 Bar (–14.5 to 43.5 PSIG)
010V = –1 to 10 Bar (–14.5 to 145 PSIG)
016V = –1 to 16 Bar (–14.5 to 232 PSIG)
025V = –1 to 25 Bar (–14.5 to 362.5 PSIG)
040V = –1 to 40 Bar (–14.5 to 580 PSIG)
100R = 0 to 100 Bar (0 to 1450 PSIG)
250R = 0 to 250 Bar (0 to 3625 PSIG)
400R = 0 to 400 Bar (0 to 5800 PSIG)
600R = 0 to 600 Bar (0 to 8700 PSIG)

Housing

3 = Non-Rotatable
5 = Rotatable

Process Connection

01 = Female G 1/4
02 = Female NPT 1/4
03 = Male NPT 1/4
04 = Male G 1/4
05 = Male 7/16 - 20 UNF (SAE-ORB)

Electrical Connection

H1141 = 4-pin male, M12X1

With LED

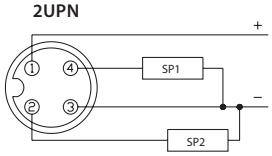
Operating Voltage

8 = 18 - 30 VDC

Electrical Output

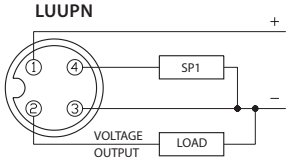
OUTPUT:	SP1	SP2/LOAD
2UPN = Switching output or IO-Link		Switching output
LUUPN = Switching output or IO-Link		Voltage output
LI2UPN = Switching output or IO-Link		Current/Switching output

2UPN



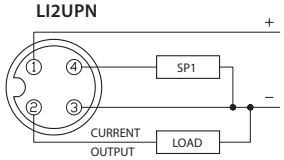
Mating Cordset: RK 4 . 4T-*

LUUPN



Mating Cordset: RK 4 . 4T-*/S618

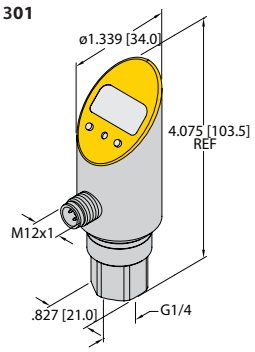
LI2UPN



Mating Cordset: RK 4 . 4T-*/S618

Non-Rotatable

301



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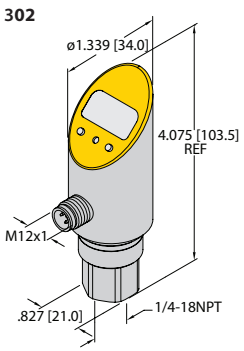

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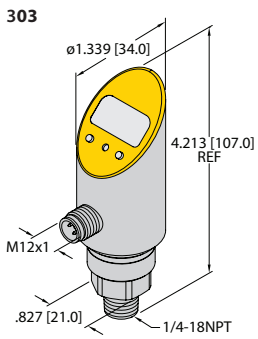

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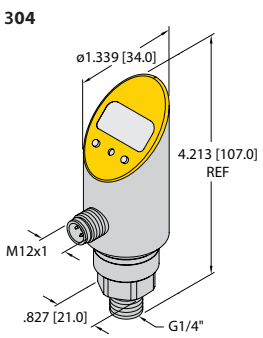
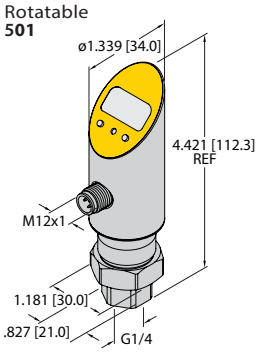


Rotatable

501



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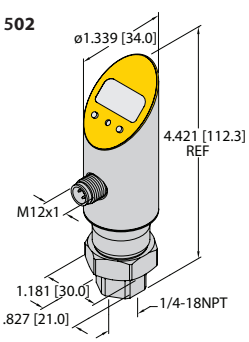

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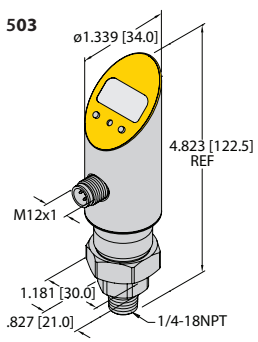

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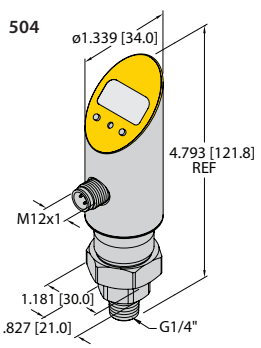

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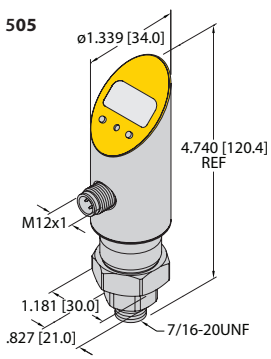


PK Series Programmable Pressure Switches

The PK series pneumatic pressure switch combines a fully programmable sensor with a digital display for local indication of pressure. This sensor is ideal for general purpose pneumatic applications where cost and performance are required.

- Fully programmable output, display units and output functionality
- Pneumatic applications only
- Process connection NPT 1/8
- M8x1 Picofast electrical connection
- Two pressure ranges available: –1 to 0 Bar and 0 to 10 Bar

Performance Data	
Over Pressure	≤ 5 Bar (01VR) ≤ 16 Bar (010R)
Burst Pressure	≥ 5 Bar (01VR) ≥ 16 Bar (010R)
Programmable Output Type	2X PNP
Set Point Accuracy	≤ ± 1% full scale
Switch Point	0 - 100% measuring range
Repeatability	0.02% full scale

Electrical Data	
Operating Voltage	10.8 - 30 VDC
Current Consumption	< 35 mA
Switching Frequency	≤ 400 Hz
Response Time	< 2.5 ms

Environmental Data	
Ambient Temperature	–20 to 85 °C
Storage Temperature	–20 to 85 °C
Medium Temperature	0 to 50 °C
Housing Materials	Pico - ABS, Plastic; Nano - AL, PVC
Materials Exposed To Medium	Silicone, ABS, AL, Nickle plated brass
Protection Type	IP 65
Shock Resistance	10 g XYZ
Vibration Resistance	10 to 55 HZ, 1.5 mm, 3 planes
LED Measuring Value	3-digit 7-segment display

Part Number Key

PK | 010R | - | N | 14 | AL | - | 2UP8X | - | V1141

Pressure Sensor

Pressure Range and Scale

01VR = –1 to 0 Bar (–14.5 to 0 PSIG)
010R = 0 to 10 Bar (0 to 145 PSIG)

Housing

P = Pico
N = Nano*

Process Connection

14 = Male NPT 1/8

Electrical Connection

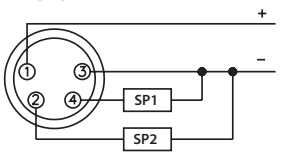
V1141 = 4-pin male, M8

Electrical Output

OUTPUT: **SP1 & SP2**

2UP8X = Switching output 10.8 - 33 VDC

2UP8X

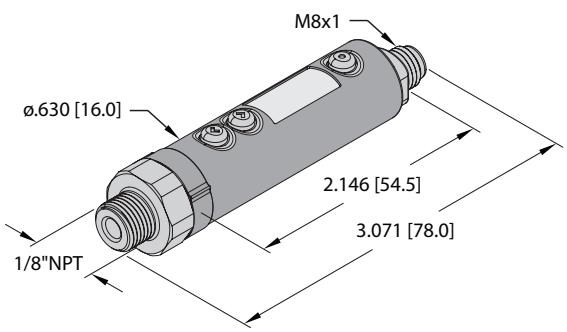


Mating Cordset: PKG 4M-*

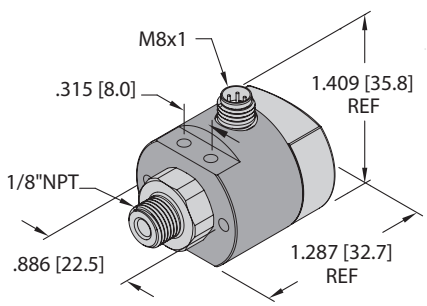
Material Detail

AL = Aluminum housing for *Nano (N14)** only

P 14



N 14 AL



PC Series Programmable Pressure Switches

The PC200 pressure switch features dual set points, which can be configured via IO-Link. This sensor has no integral programming buttons, eliminating the possibility of local changes to the parameters. With a rugged stainless steel housing, the PC200 will perform in demanding applications where the display is not desired.

- Programmable set points through IO-Link
- Rugged 303 stainless steel housing
- NPT and G (BSPP) process connections
- Ranges up to 600 Bar
- IO-Link

Performance Data	
Over Pressure	≤ 2X full scale
Burst Pressure	≥ 3X full scale
Programmable Output Type 2UPN8X	2X PNP/NPN N.O./N.C
Set Point Accuracy	± 0.5% full scale
Set Point Range	1 - 100% measuring range
Reset Point Range	0.5 - 99.5% measuring range
Set Point Hysteresis	± 0.5% full scale
Repeatability	≤ 0.5% measuring range
Temperature Coefficient Zero Point	± 0.3% of full scale per 10 °C
Temperature Coefficient Span	± 0.3% of full scale per 10 °C

Electrical Data	
Operating Voltage	15 - 30 VDC
Current Consumption	≤ 12 mA
Voltage Drop	≤ 2 V
Switching Frequency	≤ 180 Hz
Response Time	< 3 ms
Short Circuit/Reverse Polarity Protection	Yes/Yes
IO-Link	Version 1.0

Environmental Data	
Ambient Temperature	–40 to 80 °C
Storage Temperature	–40 to 80 °C
Medium Temperature	–40 to 85 °C
Housing Materials	303 stainless steel
Wetted Materials	303 stainless steel, FPM, AL_20_3 ceramic
Protection Type	IP 69K
Shock Resistance	50 g per IEC 68-2-27
Vibration Resistance	20 g (9 - 2000 Hz) per IEC 68-2-6

Part Number Key

PC	010V	-	2	03	-	2UPN	8	X	-	H1141

Pressure Switch

Pressure Range and Scale

01VR = –1 to 0 Bar (–14.5 to 0 PSIG)
001R = 0 to 1 Bar (0 to 14.5 PSIG)
001V = –1 to 1 Bar (–14.5 to 14.5 PSIG)
003V = –1 to 3 Bar (–14.5 to 43.5 PSIG)
010V = –1 to 10 Bar (–14.5 to 145 PSIG)
016V = –1 to 16 Bar (–14.5 to 232 PSIG)
025V = –1 to 25 Bar (–14.5 to 362.5 PSIG)
040V = –1 to 40 Bar (–14.5 to 580 PSIG)
100R = 0 to 100 Bar (0 to 1450 PSIG)
250R = 0 to 250 Bar (0 to 3625 PSIG)
400R = 0 to 400 Bar (0 to 5800 PSIG)
600R = 0 to 600 Bar (0 to 8700 PSIG)

Housing

2 = Cylinder without display

Process Connection

01 = Female G 1/4
02 = Female NPT 1/4
03 = Male NPT 1/4
04 = Male G 1/4

Electrical Connection

H1141 = 4-pin male, M12X1

With LED

Operating Voltage

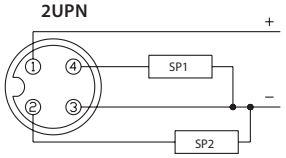
8 = 15 - 30 VDC

Electrical Output

OUTPUT: **SP1** **SP2**

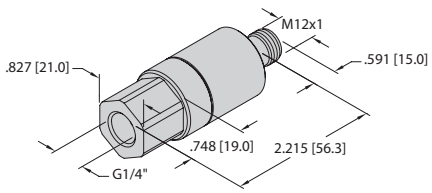
2UPN = Switching output or IO-Link — Switching output

2UPN



Mating Cordset: RK 4 . 4T-*

PC…201



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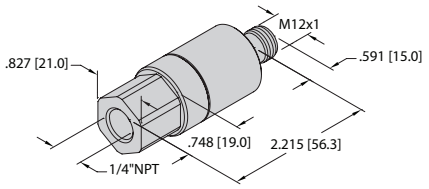

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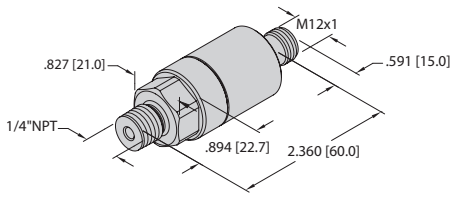

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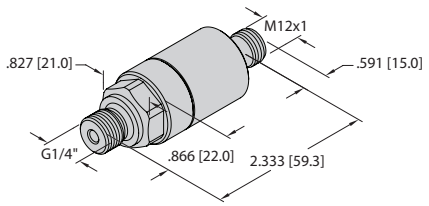
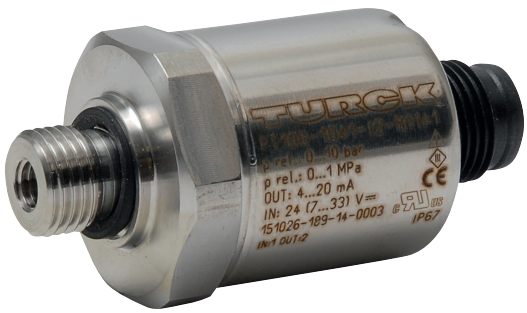


PT1000 Series Pressure Transmitters

The PT1000 series pressure transmitter offers excellent performance at an OEM price. The transmitter features a ceramic measuring cell that is well suited for general purpose pressure measurement applications. Features like a compact stainless steel housing, integral M12 connector, flexible process connections, and multiple pressure ranges ensure the product will fit the application.

- Ceramic measuring elements
- 316 stainless steel housing with Polyarylamide 50% GF electrical connector
- NPT, G (BSPP), and SAE-ORB process connections
- Gel filled housing
- Ranges up to 60 Bar



Performance Data	
Over Pressure	≤ 4 bar = 3X full scale > 4 bar = 2.5X full scale
Burst Pressure	≤ 4 bar = 3X full scale > 4 bar = 2.5X full scale
Analog Accuracy LHR	± 0.30% full scale
Temperature Coefficient Zero Point	± 0.20% of measuring range per 10 °C
Temperature Coefficient Span	± 0.20% of measuring range per 10 °C

Electrical Data	
Operating Voltage (I2 & U3)	7 - 33 VDC
Operating Voltage (U1)	12 - 33 VDC
Operating Voltage (U2)	8 - 33 VDC
Operating Voltage (U6)	5 VDC regulated
Current Consumption (I2)	≤ 23 mA
Current Consumption (U1, U2, U3, U6)	≤ 7 mA
Analog Load (I2)	≤ supply voltage - 7 V / 0.02 A = Ω
Analog Load (U1, U2, U3, U6)	> 10 K Ω
Response Time	< 2 ms
Short Circuit / Reverse Polarity Protection	Yes / Yes

Environmental Data	
Ambient Temperature	–30 to 85 °C
Storage Temperature	–50 to 100 °C
Medium Temperature	–40 to 125 °C
Housing Materials	316 stainless steel / Polyarylamide 50% GF
Wetted Materials	316 stainless steel, FPM, AL_20_3 ceramic
Protection Type	IP 67
Shock Resistance	40 g for 6 ms, 1000x all 3 directions per IEC 68-2-29
Vibration Resistance	20 g, 15 - 2000 Hz, 15 - 25 Hz with amplitude µ 15 mm, 1 Octave/min. all 3 directions, 50 constant load per IEC 68-2-6

Part Number Key

PT | 010R | - | 10 | 01 | - | I2 | - | H1141

Pressure Transmitter

Pressure Range and Scale

Absolute Range

1A = 0 to 1 BarA (0 to 14.5 PSIA)
2A = 0 to 1.6 BarA (0 to 23.2 PSIA)
3A = 0 to 2.5 BarA (0 to 36.25 PSIA)
4A = 0 to 4 BarA (0 to 58 PSIA)
6A = 0 to 6 BarA (0 to 87 PSIA)
10A = 0 to 10 BarA (0 to 145 PSIA)

Compound Range

0.2V = –0.2 to 0.2 Bar (–2.9 to 2.9 PSIG)
1V = –1 to 1 Bar (–14.5 to 14.5 PSIG)
1.5V = –1 to 1.5 Bar (–14.5 to 21.75 PSIG)
2.5V = –1 to 2.5 Bar (–14.5 to 36.25 PSIG)
5V = –1 to 5 Bar (–14.5 to 72.5 PSIG)
9V = –1 to 9 Bar (–14.5 to 130.5 PSIG)
15V = –1 to 15 Bar (–14.5 to 217.5 PSIG)
24V = –1 to 24 Bar (–14.5 to 348 PSIG)
40V = –1 to 40 Bar (–14.5 to 580 PSIG)

15PSIV = –15 to 15 PSIG
45PSIV = –15 to 45 PSIG
85PSIV = –15 to 85 PSIG
130PSIV = –15 to 130 PSIG
185PSIV = –15 to 185 PSIG
285PSIV = –15 to 285 PSIG
485PSIV = –15 to 485 PSIG

Relative Ranges

1VR = –1 to 0 Bar (–14.5 to 0 PSIG)
0.25R = 0 to 0.25 Bar (0 to 3.63 PSIG)
1R = 0 to 1 Bar (0 to 14.5 PSIG)
2R = 0 to 1.6 Bar (0 to 23.2 PSIG)
3R = 0 to 2.5 Bar (0 to 36.35 PSIG)
4R = 0 to 4 Bar (0 to 58 PSIG)
6R = 0 to 6 Bar (0 to 87 PSIG)
10R = 0 to 10 Bar (0 to 145 PSIG)
16R = 0 to 16 Bar (0 to 232 PSIG)
25R = 0 to 25 Bar (0 to 362.5 PSIG)
40R = 0 to 40 Bar (0 to 580 PSIG)
60R = 0 to 60 Bar (0 to 870 PSIG)

15PSIG = 0 to 15 PSIG
20PSIG = 0 to 20 PSIG
30PSIG = 0 to 30 PSIG
60PSIG = 0 to 60 PSIG
100PSIG = 0 to 100 PSIG
150PSIG = 0 to 150 PSIG
200PSIG = 0 to 200 PSIG
300PSIG = 0 to 300 PSIG
500PSIG = 0 to 500 PSIG
750PSIG = 0 to 750 PSIG
*other ranges available upon request

Series

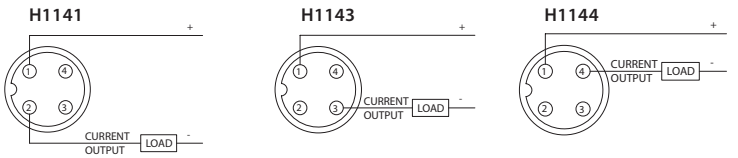
10 = Ceramic measuring cell

Process Connection

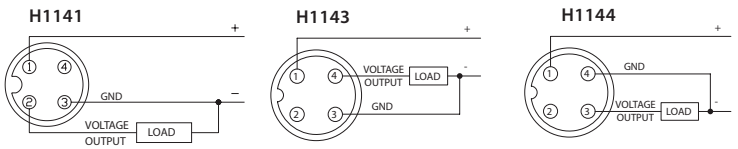
01 = Female G 1/4
03 = Male NPT 1/4
04 = Male G 1/4
05 = Male 7/16 - 20 UNF (SAE-ORB)
14 = Male NPT 1/8
17 = Female NPT 1/2

Electrical Connection

Current Output 2-wire



Voltage Output 3-wire

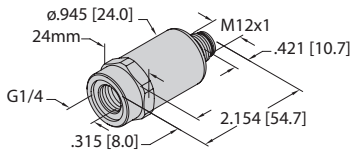


Mating Cordset: RK 4.4T-* / S618

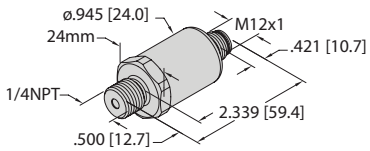
Electrical Output

I2 = 4 - 20 mA (2-wire)
U1 = 0 - 10 VDC (3-wire)
U2 = 1- 6 VDC (3-wire)
U3 = 0 - 5 VDC (3-wire)
U6 = 0.5 - 4.5% (3-wire) [ratiometric]

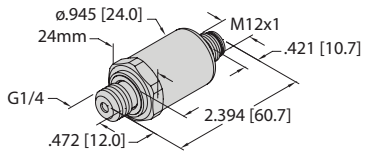
PT…1001



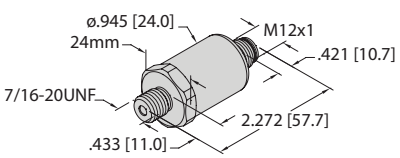
PT…1003



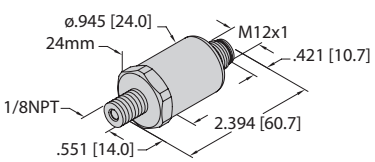
PT…1004



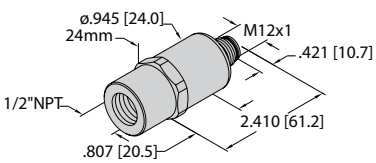
PT…1005



PT…1014



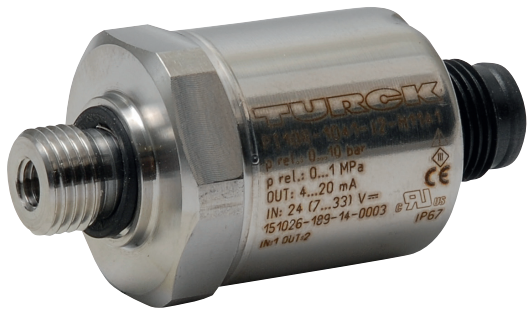
PT…1017



PT2000 Series Pressure Transmitters

The PT2000 series pressure transmitter offers excellent performance at an OEM price. The transmitter features a stainless steel measuring cell that is well suited for liquid measurement applications. The stainless measuring cell and gel filled housing inhibit liquid ingress while protecting the sensor from internal condensation common in liquid pumping applications.

- 316 welded stainless steel measuring element
- 316 stainless steel housing with Polyarylamide 50% GF electrical connector
- NPT, G (BSPP), and SAE-ORB process connections
- Gel filled housing
- Ranges up to 1000 Bar



Performance Data	
Over Pressure	≤ 6 bar = 5X full scale (max 1500 Bar) > 6 bar = 3X full scale (max 1500 Bar)
Burst Pressure	≤ 6 bar = 10X full scale (max 2500 Bar) > 6 bar = 6X full scale (max 2500 Bar)
Analog Accuracy LHR	± 0.30% full scale
Temperature Coefficient Zero Point	± 0.20% of measuring range per 10 °C
Temperature Coefficient Span	± 0.20% of measuring range per 10 °C

Electrical Data	
Operating Voltage (I2 & U3)	7 - 33 VDC
Operating Voltage (IX)	10-30 VDC
Operating Voltage (U1)	12 - 33 VDC
Operating Voltage (U2)	8 - 33 VDC
Operating Voltage (U6)	5 VDC regulated
Current Consumption (I2)	≤ 23 mA
Current Consumption (U1, U2, U3, U6)	≤ 7 mA
Analog Load (I2)	≤ supply voltage - 7 V / 0.02 A = Ω
Analog Load (U1, U2, U3, U6)	> 10 K Ω
Response Time	< 2 ms
Short Circuit / Reverse Polarity Protection	Yes / Yes
ATEX Approval (IX)	II 1/2 GD Ex ia IIC T4 Ga/Gb Ex ia IIIC T125 °C Da/Db

Environmental Data	
Ambient Temperature	–30 to 85 °C
Storage Temperature	–50 to 100 °C
Medium Temperature	–40 to 135 °C
Housing Materials	316 stainless steel / Polyarylamide 50% GF
Wetted Materials	316 stainless steel (≤ 60 bar 430 stainless steel)
Protection Type	IP 67
Shock Resistance	40 g for 6 ms, 1000x all 3 directions per IEC 68-2-29
Vibration Resistance	20 g, 15 - 2000 Hz, 15 - 25 Hz with amplitude µ 15 mm,1 Octave/min. all 3 directions, 50 constant load per IEC 68-2-6

Part Number Key

PT | 010R | - | 20 | 01 | - | I2 | - | H1141 | / | X

Pressure Transmitter

Pressure Range and Scale

Compound Range

9V = –1 to 9 Bar (–14.5 to 130.5 PSIG)
15V = –1 to 15 Bar (–14.5 to 217.5 PSIG)
24V = –1 to 24 Bar (–14.5 to 348 PSIG)

15PSIV = –15 to 15 PSIG
45PSIV = –15 to 45 PSIG
85PSIV = –15 to 85 PSIG
130PSIV = –15 to 130 PSIG
185PSIV = –15 to 185 PSIG
285PSIV = –15 to 285 PSIG
485PSIV = –15 to 485 PSIG

Relative Ranges

4R = 0 to 4 Bar (0 to 58 PSIG)
6R = 0 to 6 Bar (0 to 87 PSIG)
10R = 0 to 10 Bar (0 to 145 PSIG)
16R = 0 to 16 Bar (0 to 232 PSIG)
25R = 0 to 25 Bar (0 to 362.5 PSIG)
40R = 0 to 40 Bar (0 to 580 PSIG)
60R = 0 to 60 Bar (0 to 870 PSIG)
100R = 0 to 100 Bar (0 to 1450 PSIG)
160R = 0 to 160 Bar (0 to 2320 PSIG)
250R = 0 to 250 Bar (0 to 3625 PSIG)
350R = 0 to 350 Bar (0 to 5075 PSIG)
400R = 0 to 400 Bar (0 to 5800 PSIG)
600R = 0 to 600 Bar (0 to 8700 PSIG)
1000R = 0 to 1000 Bar (0 to 14500 PSIG)

30PSIG = 0 to 30 PSIG
60PSIG = 0 to 60 PSIG
100PSIG = 0 to 100 PSIG
200PSIG = 0 to 200 PSIG
300PSIG = 0 to 300 PSIG
500PSIG = 0 to 500 PSIG
750PSIG = 0 to 750 PSIG
1000PSIG = 0 to 1000 PSIG
2000PSIG = 0 to 2000 PSIG
3000PSIG = 0 to 3000 PSIG
5000PSIG = 0 to 5000 PSIG
7500PSIG = 0 to 7500 PSIG
14500PSIG = 0 to 14500 PSIG

Series

20 = stainless steel measuring cell

Process Connection

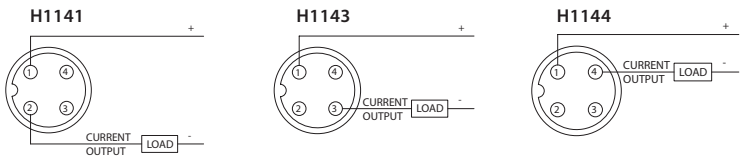
01 = Female G 1/4
03 = Male NPT 1/4
04 = Male G 1/4
05 = Male 7/16 - 20 UNF (SAE-ORB)
14 = Male NPT 1/8
17 = Female NPT 1/2
21 = Male 9/16 - 18 UNF (SAE-ORB)

Option Codes

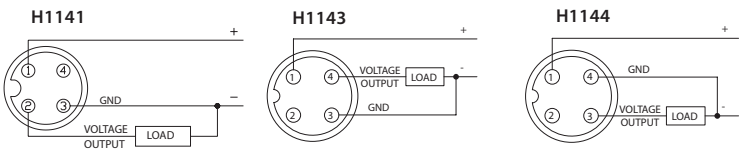
X = Orifice Snubber

Electrical Connection

Current Output 2-wire



Voltage Output 3-wire



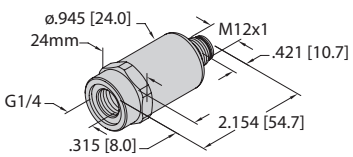
Mating Cordset: RK 4.4T-* / S618

Electrical Output

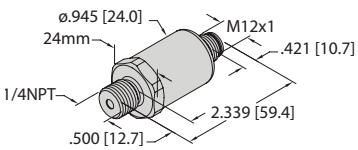
I2 = 4 - 20 mA (2-wire)
IX = 4 - 20 mA (2-wire) [ATEX]

U1 = 0 - 10 VDC (3-wire)
U2 = 1 - 6 VDC (3-wire)
U3 = 0 - 5 VDC (3-wire)
U6 = 0.5 - 4.5% (3-wire) [ratiometric]

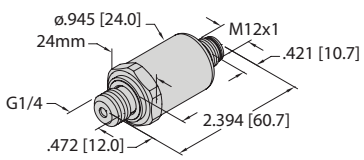
PT…2001



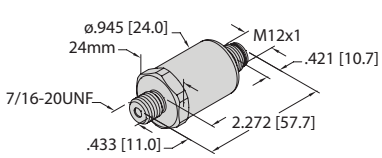
PT…2003



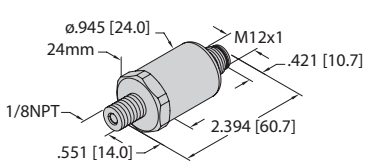
PT…2004



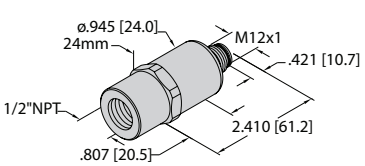
PT…2005



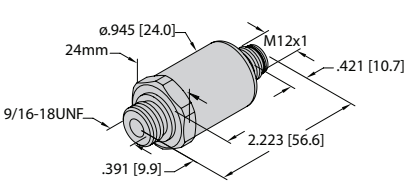
PT…2014



PT…2017



PT…2021



PT1100 Series Pressure Transmitters

The PT1100 series pressure transmitters are designed from the ground up for the challenges encountered in mobile equipment. Features such as ceramic measuring cells, integral Deutsch connectors, multiple pressure ranges, process connections, and robust electrical circuits ensure long service life.

- Ceramic measuring cell optimized for lower pressure range
- Meets international mobile equipment standards, including EMC resistance
- Gel filled stainless steel housing that minimizes failures from condensation
- Integral snubber to mitigate damage caused by pressure spikes
- Pressure ranges and process connections common on mobile hydraulic systems

Performance Data	
Over Pressure	See datasheet
Burst Pressure	See datasheet
Analog accuracy LHR	± 0.3% full scale
Thermal characteristics	± 0.2% of measuring range per 10°K
Electric Data	
Operating voltage (I2)	7.5 - 33 VDC
Operating voltage (U3)	7 - 33 VDC
Operating voltage (U6)	5 VDC (regulated)
Current consumption (I2)	≤ 23 mA
Current consumption (U3, U6)	≤ 7 mA
Analog Load (I2)	≤ (Supply voltage - 7.5) / 20KΩ
Analog Load (U3, U6)	≤ 100 nF/>10 kΩ
Response time	< 2ms, typ. 1 ms
Short Circuit/reverse polarity protection	Yes/Yes
Environmental Data	
Ambient temperature	-40° - 100°C
Storage temperature	-50° - 100°C
Medium temperature	-40°- 125°C
Housing materials	Stainless steel (1.4404) / AISI 316 L
	Polyarylamide 50% Gf UL 94 V-0
Wetted Materials	Stainless steel (1.4404) / AISI 316 L, FPM, AL_2O_3 ceramic
Protection type	IP69K / III
Vibration resistance	Test VI (12 g, sinusodial 18 g random vibration)
Shock resistance	50 g, 11 ms, half sine wave, 1000x/axis , acc. to ISO 16750-3

EMC

Interference Immunity/	EN 61326-2-3 - Pressure transducer	**Immunity Motor Vehicle Directive**	ISO 11452-2, HF (Field), 100 V/m (200…2000 MHz)
Interference Emission:	ISO 13766 - Earthmoving machinery		ISO 11452-4, HF (BCI), 100 mA (20…400 MHz)
	DIN EN 13309 - Construction machinery		ISO 10605, ESD, ±15 kV contact, ±15 kV air
	DIN ISO 14982 - Forestry and agriculture		ISO 7637-2 3), pulses 1, 2a, 2b, 3a, 3b (test level 4)
	CISPR11		ISO 16750-2, load dump, 155 V (1 Ω, 300 ms)
			Motor vehicle directive ECE R10
			Motor vehicle directive 2004/104/EC

Part Number Key

PT	100PSIG	-	11	05	-	I2	-	DT043P

Pressure Transmitter

Pressure Range and Scale

1VR = –1 to 0 Bar (-14.5 to 0 PSIG)
1V = –1 to -1 Bar (-14.5 to 14.5 PSIG)
1R = 0 to 1 Bar (0 to 14.5 PSIG)
10R = 0 to 10 Bar (-14.5 to 0 PSIG)
15PSIG = 0 to 15 PSIG
100PSIG = 0 to 100 PSIG

Series

11 = Low Pressure Mobile Equipment Transmitter

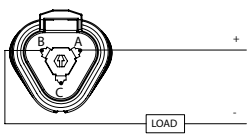
Process Connection

05 = Male 7/16 - 20 UNF (SAE-ORB)
21 = Male 9/16 - 18 UNF (SAE-ORB)
04 = Male G1/4
03 = Male 1/4 NPT

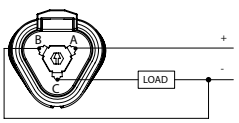
Electrical Connection

DT04-3P= DT04 Duetsch Connector

I2



U3 & U6



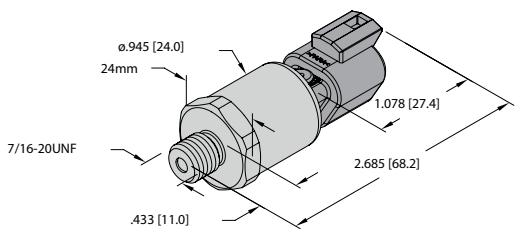
Mating Cordset: DT06-3S-1876-*

Electrical Output

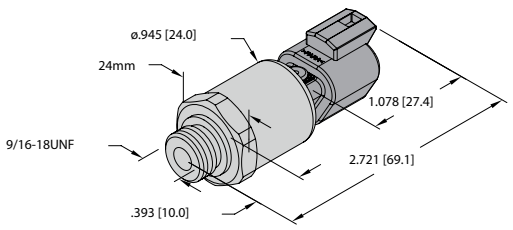
I2 = 4 - 20 mA (2-wire)
U3 = 0 - 5 VDC (3-wire)
U6 = Ratiometric (3 wire) 0.5 to 4.5 VDC

*Contact factory for additional pressure ranges, process connections, and electrical connections

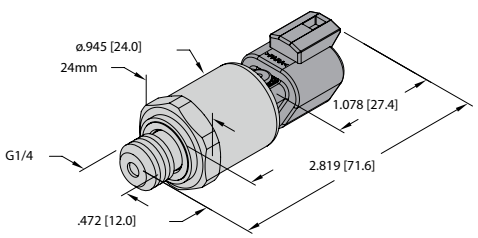
PT…1105



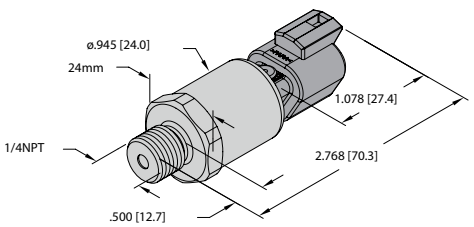
PT…1121



PT…1104



PT…1103



PT2100 Series Pressure Transmitters

The PT2100 series pressure transmitters are designed from the ground up for the challenges encountered in mobile equipment. Features such as stainless measuring cells, integral Deutsch connectors, multiple pressure ranges, process connections, and robust electrical circuits ensure long service life

- Stainless steel measuring cell
- Meets international mobile equipment standards, including EMC resistance
- Gel filled stainless steel housing that minimizes failures from condensation
- Integral snubber to mitigate damage caused by pressure spikes
- Pressure ranges and process connections common on mobile hydraulic systems

Performance Data	
Over Pressure	See datasheet
Burst Pressure	See datasheet
Analog Accuracy LHR	± 0.3% full scale
Thermal characteristics	± 0.2% of measuring range per 10°K
Electric Data	
Operating voltage (I2)	7.5 - 33 VDC
Operating voltage (U3)	7 - 33 VDC
Operating voltage (U6)	5 VDC (regulated)
Current consumption (I2)	≤ 23 mA
Current consumption (U3, U6)	≤ 7 mA
Analog Load (I2)	≤ (Supply voltage - 7.5) / 20KΩ
Analog Load (U3, U6)	≤ 100 nF/>10 kΩ
Response time	< 2ms, typ. 1 ms
Short Circuit/reverse polarity protection	Yes/Yes
Environmental Data	
Ambient temperature	-40° - 100°C
Storage temperature	-50° - 100°C
Medium temperature	-40°- 125°C
Housing materials	Stainless steel (1.4404) / AISI 316 L
	Polyarylamide 50% Gf UL 94 V-0
Wetted Materials	Stainless steel (1.4404) / AISI 316 L
Protection type	IP69K / III
Vibration resistance	Test VI (12 g, sinusodial 18 g random vibration)
Shock resistance	50 g, 11 ms, half sine wave, 1000x/axis , acc. to ISO 16750-3

EMC

Interference Immunity/ Interference Emission	EN 61326-2-3 - Pressure transducer ISO 13766 - Earthmoving machinery DIN EN 13309 - Construction machinery DIN ISO 14982 - Forestry and agriculture CISPR11	**Immunity Motor Vehicle Directive**	ISO 11452-2, HF (Field), 100 V/m (200…2000 MHz) ISO 11452-4, HF (BCI), 100 mA (20…400 MHz) ISO 10605, ESD, ±15 kV contact, ±15 kV air ISO 7637-2 3), pulses 1, 2a, 2b, 3a, 3b (test level 4) ISO 16750-2, load dump, 155 V (1 Ω, 300 ms) Motor vehicle directive ECE R10 Motor vehicle directive 2004/104/EC

Part Number Key

PT	3000PSIG	-	21	05	-	I2	-	DT043P

Pressure Transmitter

Pressure Range and Scale

500PSIG = 0 to 500 PSIG
750PSIG = 0 to 750 PSIG
1000PSIG = 0 to 1000 PSIG
2000PSIG = 0 to 2000 PSIG
3000PSIG = 0 to 3000 PSIG
3500PSIG= 0 to 3500 PSIG
5000PSIG = 0 to 5000 PSIG
6000PSIG = 0 to 6000 PSIG
7500PSIG = 0 to 7500 PSIG
40R = 0 to 40 Bar (0 to 580 PISG)
60R = 0 to 60 Bar (0 to 870 PISG)
100R = 0 to 100 Bar (0 to 1450 PISG)
160R = 0 to 160 Bar (0 to 2230 PISG)
250R = 0 to 250 Bar (0 to 3625 PISG)
400R = 0to 400 Bar (0 to 5800 PISG)
600R = 0 to 600 Bar (0 to 7500 PISG)

Series

21 = Mobile Equipment Pressure Transmitter

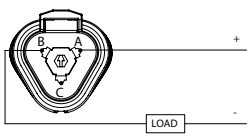
Process Connection

05 = Male 7/16"-20 UNF (SAE-ORB)
21 = Male 9/16"-18 UNF (SAE-ORB)
04 = Male G1/4
03 = Male 1/4" NPT

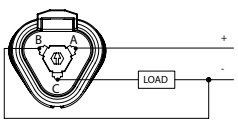
Electrical Connection

DT04-3P= DT04 Duetsch Connector

I2



U3 & U6



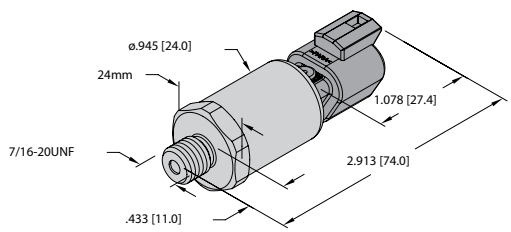
Mating Cordset: DT06-3S-1876-*

Electrical Output

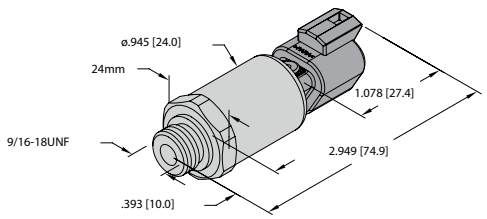
I2 = 4-20 mA (2 wire)
U3 = 0-5 VDC (3 wire)
U6 = Ratiometric (3 wire) 0.5 to 4.5 VDC

*Contact factory for additional pressure ranges, process connections, and electrical connections

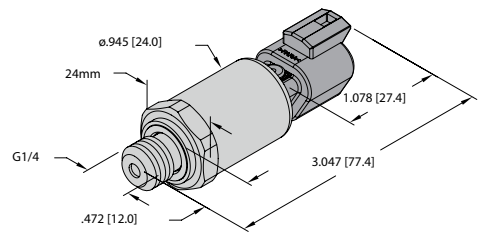
PT…2105



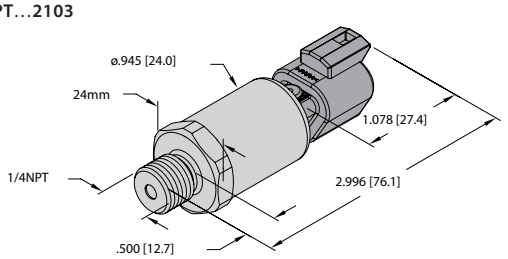
PT…2121



PT…2104



PT…2103



PT1 Series Pressure Transmitters

The PT1 pressure transmitter is a general purpose product with a ceramic measuring cell and is ideal for pneumatic applications. The rugged stainless steel housing ensures performance in demanding applications.

- Stainless steel housing
- NPT and G (BSPP) process connections
- 4 - 20 mA, 0 - 10 V
- Ranges up to 600 Bar

Performance Data	
Over Pressure	≤ 4 bar = 3X full scale > 4 bar = 2.5X full scale
Burst Pressure	≤ 4 bar = 3X full scale > 4 bar = 2.5X full scale
Analog Accuracy LHR	≤ 0.30% full scale
Zero / Span Shift	≤ 0.30% full scale
Temperature Coefficient Zero Point	≤ 0.15% of measuring range per 10 °C
Temperature Coefficient Span	≤ 0.15% of measuring range per 10 °C

Electrical Data	
Operating Voltage (LI3)	8 - 33 VDC
Operating Voltage (LU2)	11.4 - 33 VDC
Current Consumption	≤ 20 mA
Analog Load (LI3)	≤ 1 K Ω
Analog Load (LU2)	> 10 K Ω
Response Time	< 2 ms
Short Circuit / Reverse Polarity Protection	Yes / Yes

Environmental Data	
Ambient Temperature	–40 to 85 °C
Storage Temperature	–40 to 85 °C
Medium Temperature	–40 to 125 °C
Housing Materials	303 stainless steel
Wetted Materials	303 stainless steel, FPM, PPS, AL_20_3 ceramic
Protection Type	IP 67
Shock Resistance	75 g, 11 ms per IEC 68-2-27
Vibration Resistance	20 g, 15 mm per IEC 68-2-6

Part Number Key

PT | 010R | - | 1 | 1 | - | LI3 | - | H1131

Pressure Transmitter

Pressure Range and Scale

Absolute Range

001A = 0 to 1 BarA (0 to 14.5 PSIA)
002A = 0 to 1.6 BarA (0 to 23.2 PSIA)
003A = 0 to 3 BarA (0 to 43.5 PSIA)

Relative Ranges

01VR = –1 to 0 Bar (–14.5 to 0 PSIG)
0.5R = 0 to 0.5 Bar (0 to 7.25 PSIG)
001R = 0 to 1 Bar (0 to 14.5 PSIG)
002R = 0 to 1.6 Bar (0 to 23.2 PSIG)
003R = 0 to 2.5 Bar (0 to 36.25 PSIG)
004R = 0 to 4 Bar (0 to 58 PSIG)
006R = 0 to 6 Bar (0 to 87 PSIG)
010R = 0 to 10 Bar (0 to 145 PSIG)
016R = 0 to 16 Bar (0 to 232 PSIG)
025R = 0 to 25 Bar (0 to 362.5 PSIG)
040R = 0 to 40 Bar (0 to 580 PSIG)
060R = 0 to 60 Bar (0 to 870 PSIG)
100R = 0 to 100 Bar (0 to 1450 PSIG)
160R = 0 to 160 Bar (0 to 2320 PSIG)
250R = 0 to 250 Bar (0 to 3625 PSIG)
400R = 0 to 400 Bar (0 to 5800 PSIG)
600R = 0 to 600 Bar (0 to 8700 PSIG)

–30HG = –30 to 0 in HG
15PSIG = 0 to 15 PSIG
30PSIG = 0 to 30 PSIG
60PSIG = 0 to 60 PSIG
100PSIG = 0 to 100 PSIG
200PSIG = 0 to 200 PSIG
300PSIG = 0 to 300 PSIG
500PSIG = 0 to 500 PSIG
750PSIG = 0 to 750 PSIG
1000PSIG = 0 to 1000 PSIG
2000PSIG = 0 to 2000 PSIG
3000PSIG = 0 to 3000 PSIG
5000PSIG = 0 to 5000 PSIG
7500PSIG = 0 to 7500 PSIG

Series

1 = PT1

Process Connection

1 = Female G 1/4
3 = Male NPT 1/4

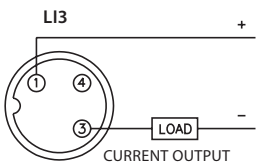
Electrical Connection

H1131 = 3-pin, M12

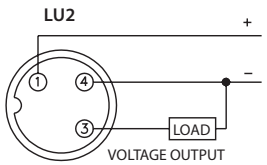
Electrical Output

OUTPUT: **LOAD**

LI3 = 4 - 20 mA
LU2 = 0 - 10 VDC

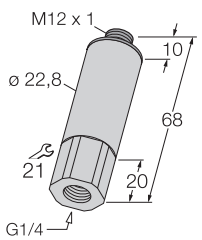


Mating Cordset: RK 4T-* / S618

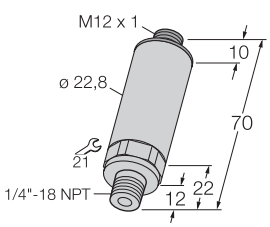


Mating Cordset: RK 4T-* / S618

PT…11

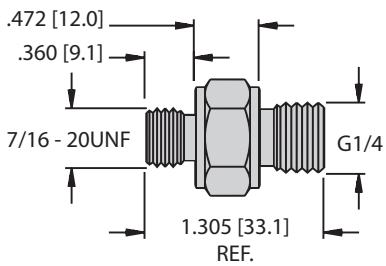


PT…13

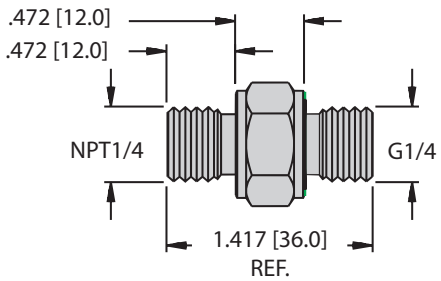


Accessories

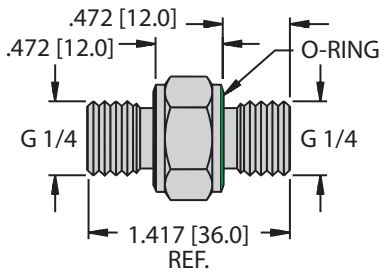
Process Connection Adaptors



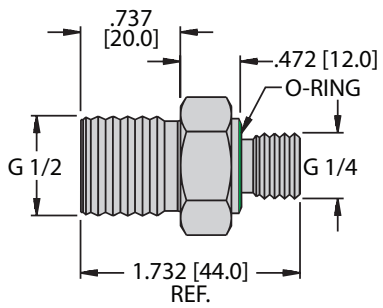
PCV-S7/16A4 | A9136



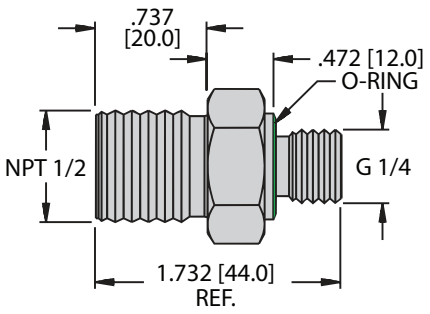
PCV-N1/4A4 | A9867



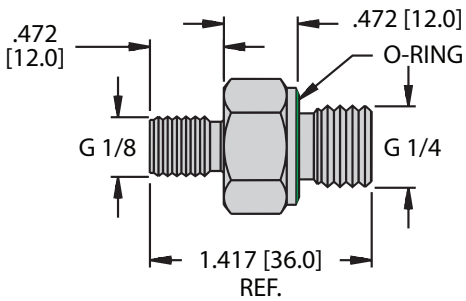
PCV-G1/4A4 | M6835011



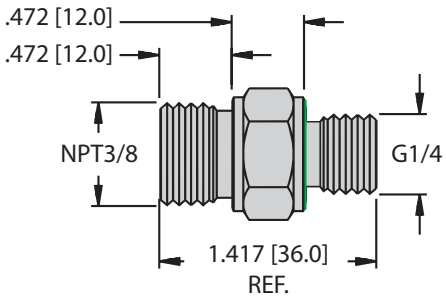
PCV-G1/2A4 | M6835012



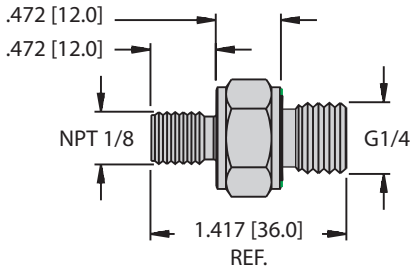
PCV-N1/2A4 | M6835013



PCV-G1/8A4 | M6835014

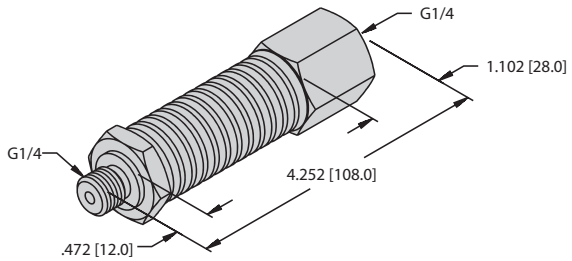


PCV-N3/8A4 | M6835020



PCV-N1/8A4 | M6835021

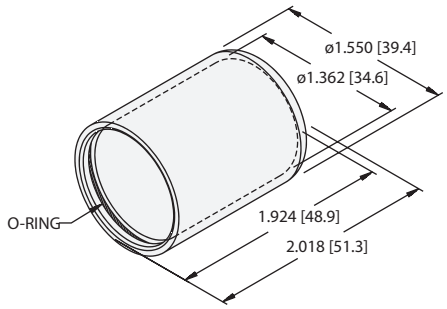
Protective Adaptors



Heat Exchanger

PCS-G1/4A4 | M6835015

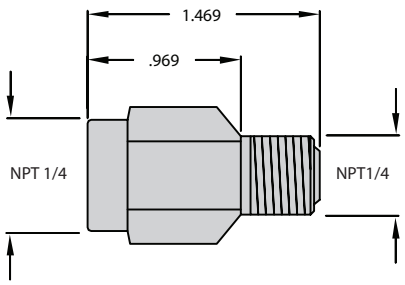
***view High Temperature Applications on page 30*



PS Series Cover

PTS-COVER | A9350

NOTE: only works with PS series sensors

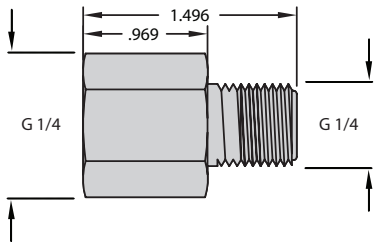


Pressure Snubber

PSC-N1/4A4-OIL | 100000742

PSC-N1/4A4-WATER | 100000741

**view Pressure Spike And Transients on page 29*



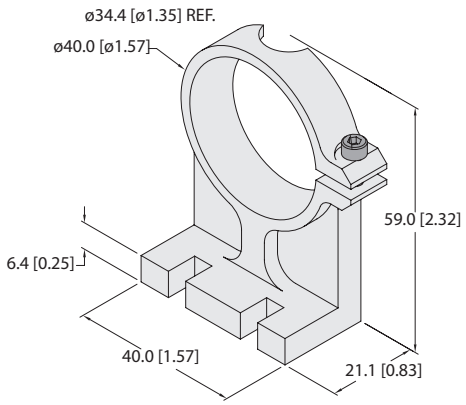
Pressure Snubber

PSC-G1/4A4-OIL | 100000744

PSC-G1/4A4-WATER | 100000740

**view Pressure Spike And Transients on page 29*

Mounting Adaptors



Mounting Brackets

PS/TS-MBT | A9919

NOTE: only works with PS series sensors

Diaphragm Seal Selection

A diaphragm seal works as an isolator between the pressure sensor and the process media. They are commonly used for corrosive applications where compatibility is an issue, sanitary applications where a 3A or food grade rating is required, and where a clean out is required due to media that may build up on the sensor face over time. Diaphragms can be made of many different materials; typically the upper housing is made of the same or similar material as the sensor, because it does not come in contact with the process media. The diaphragm and lower housing can come in different materials. This ensures compatibility of process media that is not compatible with the sensor. For example, salt water will corrode stainless steel over time but will not affect Hastelloy.

Assembly Part Numbers

Diaphragm S numbers are added to the end of the sensor part number. In order to place an order with a diaphragm:

1. You will first want to pick the correct sensor for your application (ex: PS010V-303-LI2UPN8X-H1141).

2. Then pick the diaphragm with the housing materials needed (ex: PS010V-303-LI2UPN8X-H1141/S1604).
*NOTE: *more information about /S1604 diaphragm on page 23*

3. Contact applications for chemical compatibility and other optional materials not listed to prolong the life of the sensor.

① **UPPER**
The upper housing does not come in contact with the process media.

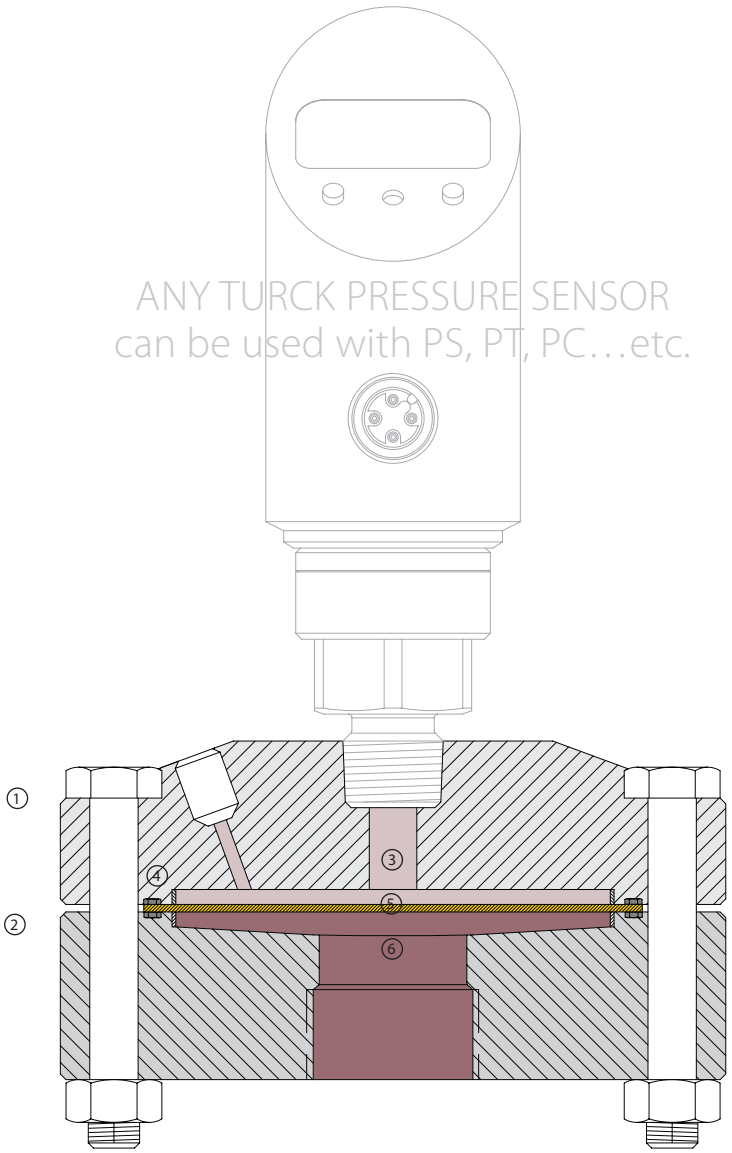
② **LOWER**
The lower housing and diaphragm should be the same material, as they are both in contact with the process media.

③ **FLUID FILL**
This is a non-compressible fluid. In general applications, Silicone DC200 is used. For sanitary applications, Neobe M20 is generally used.

④ **O-RING**
O-rings seal the upper and lower housings to the diaphragm.

⑤ **DIAPHRAGM**
The diaphragm is the barrier between the process media and the fluid fill/sensor.

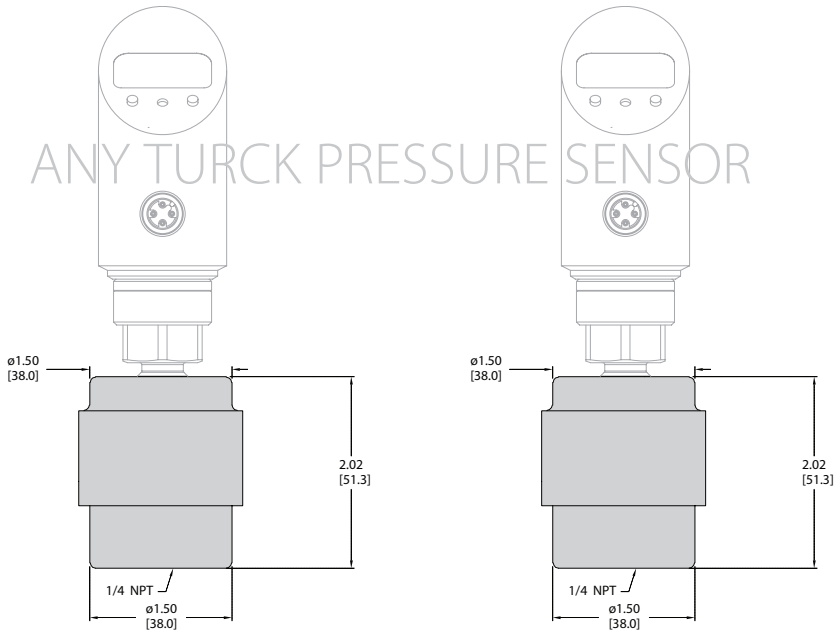
⑥ **PROCESS CONNECTION**
This is where the process media (1/4 or 1/2 NPT) enters the assembly.



Fully Welded Diaphragms

In applications where corrosive medias are present, fully welded diaphragm seals may be added to any of Turck's pressure sensors.

These diaphragms act as a barrier between the media and the pressure sensors wetted materials, and can be made of various materials to allow for minimal reaction and a prolonged life of the sensor.

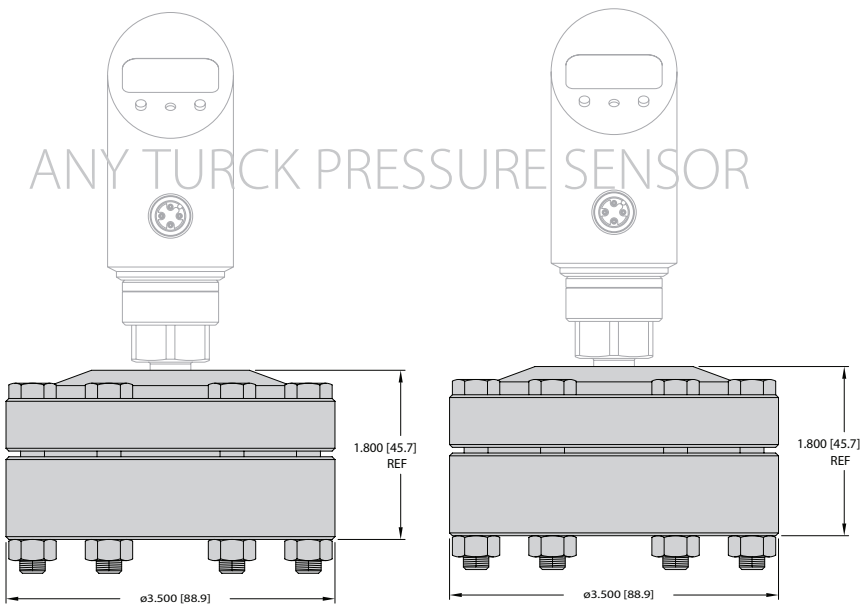


Fully Welded Diaphragm Seal		
Part Numbers	S1685	S1262
Upper Housing Material	316L	316L
Lower Housing Material	316L	Hastelloy C-276
Fluid Fill Material	silicone DC200	silicone DC200
Diaphragm Material	316L	Hastelloy C-276
Process Connection	1/4" Female NPT	1/4" Female NPT
Maximum Working Pressure (at 100 °F)	2500 PSI	2500 PSI

Three Piece Assembled Diaphragms

In applications where corrosive medias are present, three piece assembled diaphragm seals may be added to any of Turck's pressure sensors.

These diaphragms act as a barrier between the media and the pressure sensors wetted materials, and can be made of various materials to allow for minimal reaction and a prolonged life of the sensor. The larger diaphragm increases the resolution and should be used with low pressure ranges (must be used when the lower housing and diaphragm cannot be welded due to material).

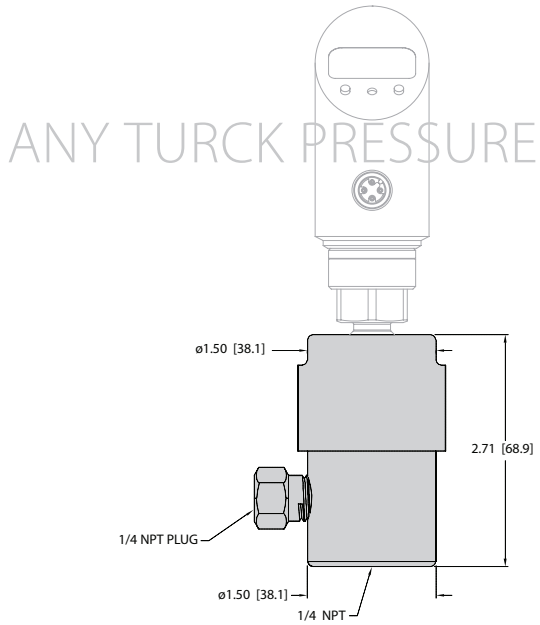


Three Piece Assembled Diaphragm Seal		
Part Numbers	S1049	S1731
Upper Housing Material	316L	316L
Lower Housing Material	316L	PVC
Fluid Fill Material	silicone DC200	silicone DC200
Diaphragm Material	316L	Hastelloy C-276
Process Connection	1/2" Female NPT	1/2" Female NPT
Maximum Working Pressure (at 100 °F)	2500 PSI	2500 PSI

Fully Welded Diaphragms With Clean Out

In applications with medias present that can either build up over time or may clog the sensor, fully welded diaphragm seals with clean-out may be added to any of Turck's pressure sensors.

The clean out port allows for quick and easy cleaning of the diaphragm and lower housing.

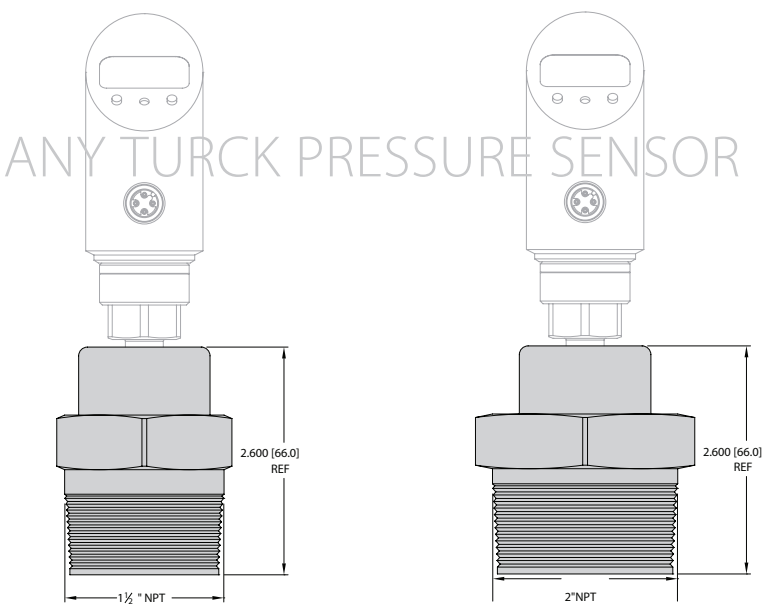


Fully Welded Diaphragm Seal With Clean Out	
Part Numbers	S1593
Upper Housing Material	316L
Lower Housing Material	316L
Fluid Fill Material	silicone DC200
Diaphragm Material	316L
Process Connection	1/4" Female NPT
Maximum Working Pressure (at 100 °F)	2500 PSI

Flush Mount Diaphragms

In applications with medias present that can either build up over time or may clog the sensor, flush mount diaphragm seals may be added to any of Turck's pressure sensors.

The diaphragm is located on the bottom of the process connection, eliminating any orifices to clog.

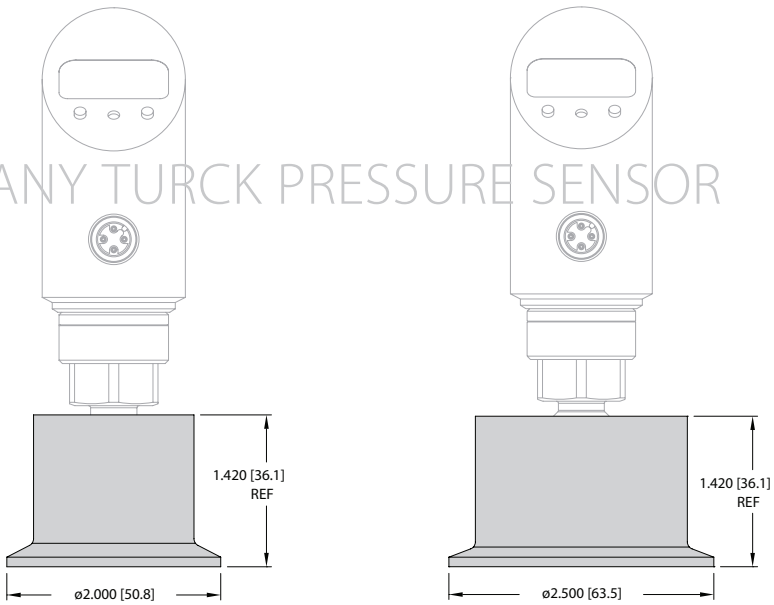


Flush Mount Diaphragm Seal		
Part Numbers	S1704	S1705
Upper Housing Material	316L	316L
Lower Housing Material	316L	316L
Fluid Fill Material	silicone DC200	silicone DC200
Diaphragm Material	316L	316L
Process Connection	1.5" Male NPT	2" Male NPT
Maximum Working Pressure (at 100 °F)	2500 PSI	2500 PSI

Sanitary Diaphragms

In applications with sanitary medias, a sanitary diaphragm seal can be added to any of Turck's pressure sensors.

The diaphragm is made of food grade Stainless steel with a micro finish that meets or exceeds the 3A requirements.



Sanitary Diaphragm Seal		
Part Numbers	S1604	S1605
Upper Housing Material	316L	316L
Lower Housing Material	316L	316L
Fluid Fill Material	Neobe M20	Neobe M20
Diaphragm Material	316L	316L
Process Connection	1.5" Triclamp	2" Triclamp
Maximum Working Pressure (at 100 °F)	600 PSI	600 PSI

Application Considerations

Sizing Pressure Sensors

When sizing a pressure sensor, you typically want to over size for the application. This will allow for any over pressures that may occur. For instance, if you are running an application that is always at 100 PSI in a dynamic application, you will want to spec in a transmitter that is 50% larger (or the next size up that is reasonable). Keeping the process pressure within that range will help with any pressure spike failures that are caused by system start up or other system processes. In the case of level static applications, oversizing the pressure sensor approximately 10% is all that is needed, providing best resolution for your application.

Pressure Units

There are many types of pressure units, all of which can be converted by a constant. Outlined below are the common units and how to convert between them (*Fig. 2)*.

Pressure Sensor Measurement Types

There are different types of pressure measurement. Below are a few that Turck has to offer. To help further the explanation of the measurement types, see Sensor References (*pg. 25*) for a deeper look into the terminology.

Absolute sensors will have a pressure zero reference to absolute pressure.

Gauge sensors will have a pressure zero reference to atmosphere.

Sealed sensors will have a sealed zero reference that is not open to atmosphere or to absolute vacuum.

Compound sensors have a gauge zero reference, but are able to go from a vacuum to a positive pressure, the zero point of the sensor is atmospheric pressure.

Differential sensors use two measurement cells; one for high pressure and one for low pressure. The differential pressure is Cell 1 - Cell 2.

Pressure Units Conversion Chart

UNIT	bar	mbar	Pa	kPa	mPa	mmHg	PSI	1" WC
bar	1	1000	100000	100	0.1	0.0013	14.5038	0.0025
mbar	1000	1	100	0.1	0.0001	1.3332	0.0145	2.4884
Pa	100000	100	1	0.001	1.00E-06	133.3224	0.000145	248.84
kPa	100	0.1	0.001	1	0.001	0.1333	0.145	0.2488
mPa	0.1	0.0001	1.00E-06	0.001	1	0.0001	145.0377	0.0002
mmHg	750.0617	0.75	0.0075	7.5006	0.0001	1	0.01934	0.5352
PSI	14.5038	0.0145	0.0001	0.145	145.0377	0.01934	1	0.0361
1"WC	401.865	0.4019	0.00402	0.2488	0.0002	0.5352	0.0361	1

Fig. 2

Sensor References

All pressure sensors have a reference point, and there are different types of reference points available. The reference point helps keep the zero point of the transmitter at a constant value. Depending on the application, it may be necessary to use different types of pressure references for the device. To the right are the three most common types.

Pressure sensors get their reference via a hole on the side, top, or bottom of the sensor, which is usually sealed by a hydrophobic material. Alternatively, pressure sensors can get their reference via a vent tube. This is the only way a submersible sensor can get its reference, unless sealed or absolute. This is achieved by having a tube that runs through the electrical cable to allow a vent between atmosphere and the back side of the measuring cell (*Fig. 3*).

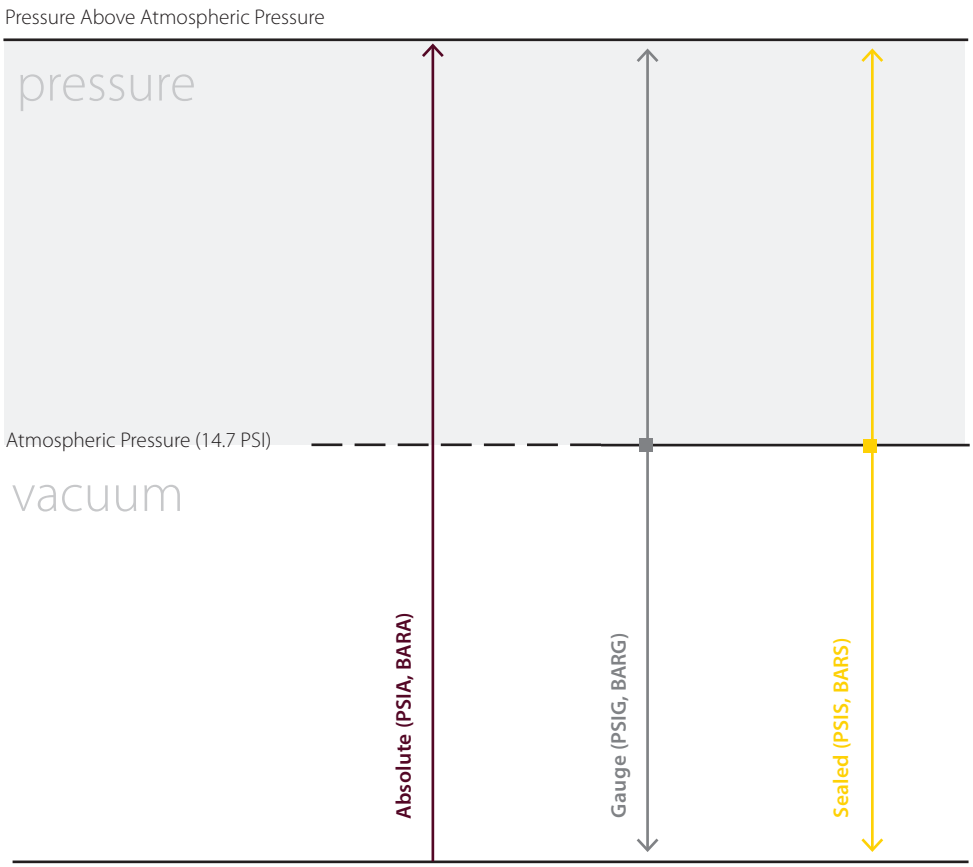


Fig. 3

→ **Absolute (PSIA, BARA)** reference is when the back side of the pressure sensor's measuring cell is placed under a vacuum and is sealed. This shifts the sensors zero point to a value of –1 bar. This reference is commonly used to detect changes in barometric pressure.

↔ **Gauge (PSIG, BARG)** reference is when the back side of the pressure sensor is open to atmospheric pressure. This is the most common type of reference on a pressure sensor,
as it allows for the zero point to move with atmospheric conditions.

↔ **Sealed (PSIS, BARS)** reference is when the back side of the pressure sensor is sealed when manufactured. This may induce a small error when used in different elevation from where it was manufactured. This is commonly used to increase the sensors IP rating or to help alleviate water intrusion.

Atmospheric Pressure is the amount of pressure produced by the weight of the atmosphere. This can change relative to elevation from sea level as well as shifts in barometric pressure.

Sensor Accuracy

Accuracy is the maximum deviation from the theoretical linear line between a sensors zero and span output seen by the characteristic curve observed in testing under specified conditions and by a specified procedure. Accuracy must include Linearity, Hysteresis, and Repeatability (LHR).

Non-Linearity is where inconsistency comes in. Two methods are typically used: **Best Fit Straight Line (BFSL),** and **Full Scale (FS)** or Terminal Point.

Hysteresis is the maximum difference in sensor output at a pressure when that pressure is first approached with pressure increasing, and then approached with pressure decreasing during a full span pressure cycle.

Non-Repeatability is the maximum difference in output when the same pressure is applied, consecutively, under the same conditions and approaching from the same direction.

If accuracy is an important characteristic in specifying the pressure transmitter, it may be important to calculate the total error band
of the sensor.

The total error band accounts for accuracy, sensor stability, thermal effect on zero/span, and zero/span shift. This will take into account all of the potential errors that may be induced on the sensor. Total error band is calculated with the below formula:

$$\text{Total error band} = \sqrt{[(\text{accuracy}^2) + (\text{stability}^2) + (\text{TE zero}^2) + (\text{TE span}^2) + (\text{zero shift}^2) + (\text{span shift}^2)]}$$

Temperature Effects On Accuracy

Temperature behavior on a pressure sensor can be represented in two ways. The first way would be to give a temperature compensated range on the device; this is the range where the sensors testing was done and the accuracy LHR % holds true. Outside of the temperature compensated range, there may be an increased accuracy deviation. This is usually shown on the data sheet as the temperature compensated zero/span value.

The second way this is represented would be to give the sensor an accuracy deviation per a given temperature deviation (i.e., the PT2000 series). The zero and span shift represent an error that can be induced from operating the sensor outside of reference condition. The reference condition for temperature on this series is 15 to 25 °C. For example, if you were operating the sensor between 26 °C and 35 °C, it could shift the linear line an added ± 0.15%.

In regards to accuracy deviations, please keep in mind that these are not simply added together. For instance, since the device has an accuracy of 0.3%—and an added 0.15% in the example above due to operating at 10 °C above the reference condition—the total is not 0.45%. To properly calculate accuracy deviations, add the root of the sums squared using the formula below:

$$\sqrt{[(0.3)^2 + (0.15)^2]}$$

$$\sqrt{[0.09 + 0.0225]} = \pm 0.34\%$$

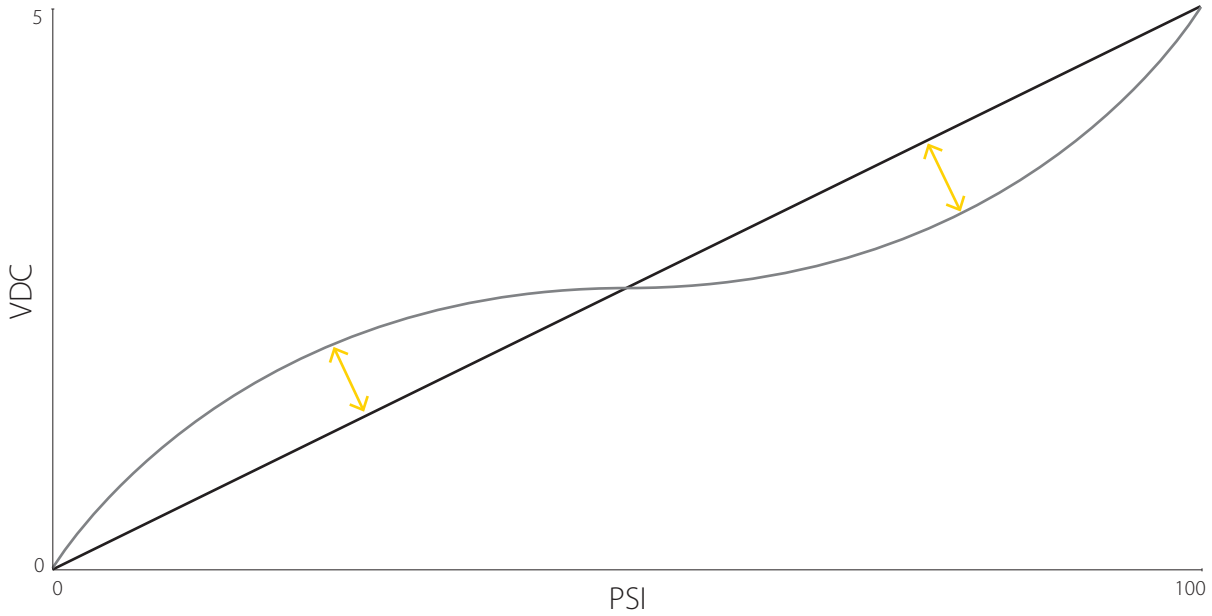
In the example below, the device is operating at a maximum temperature range of 125 °C, which is 100 °C above the reference condition. The total error induced by the increased temperature would be calculated as follows:

$$\sqrt{[(0.3)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2 + (0.15)^2]} = \pm 0.56\%$$

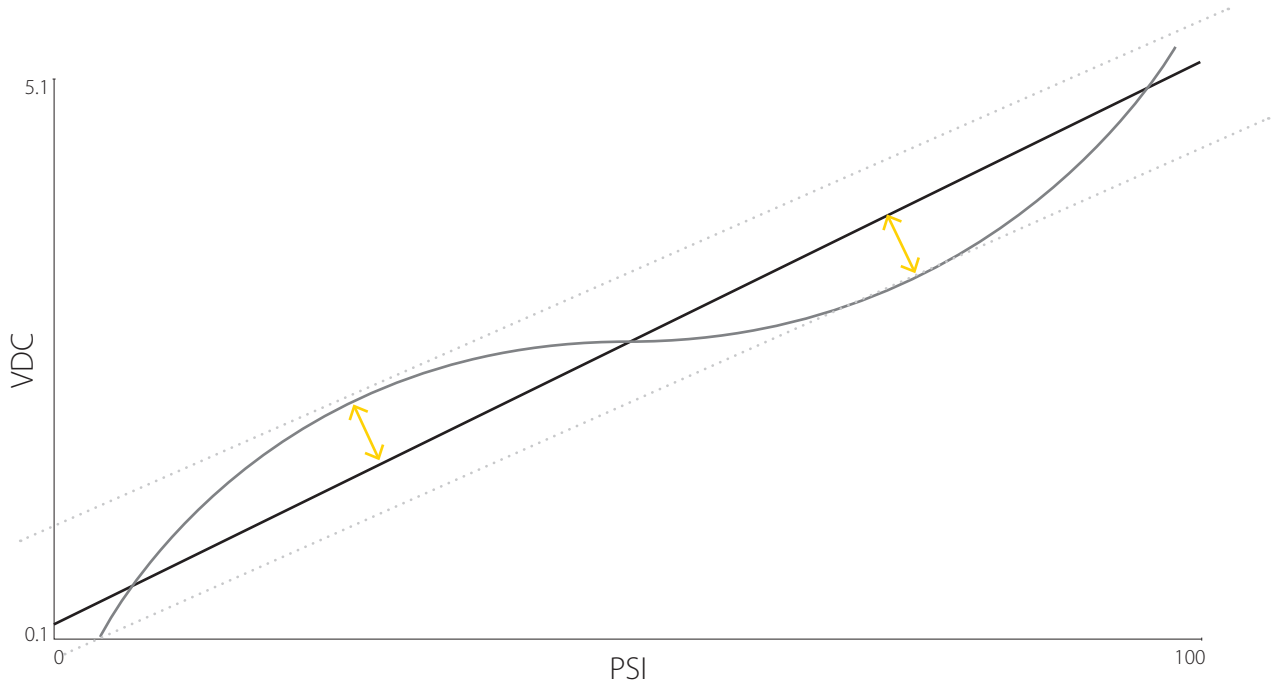
Generally, when a shift occurs it will move the zero and span in the same direction.

Accuracy typically is called out as an LRH%, which is calculated using the below formula:

Accuracy | LRH% $= \sqrt{[(\text{non-linearity}^2) + (\text{non-repeatability}^2) + (\text{hysteresis}^2)]}$



Full scale accuracy (FS) is the relationship of plotted characteristics of the pressure cell and the calculated straight line that starts and stops at the cells endpoints. The greatest deviation from the linear line would be the accuracy deviation.



Best Fit Straight Line (BFSL) is the relationship of the plotted characteristics of the pressure cell and a calculated straight line that does not pass through the end points. The linear line is placed in the center of the accuracy deviation to minimize error.

Measuring Liquid Level With A Pressure Sensor

There are multiple ways to use pressure sensors in liquid level measuring applications. One method involves a sensor that is submerged in the media and is mounted inside of the tank. The sensor may or may not be in contact with the bottom of the tank; in some instances it is problematic for the sensor to be on the bottom of the tank due to debris. In a static tank it may not be necessary to support the sensor, but in a turbulent tank it may be beneficial to use a conduit or a strain relief to control the orientation and stress on the sensor and its cable.

Another way to use pressure in a level application is to place the sensor on the bottom of the exterior of the tank via plumbing. The sensor will have to be mounted in the lowest possible position to reduce the amount of offset that cannot be seen by the sensor. This type of configuration is common in the food/beverage industry, where consumables cannot be contaminated, and also reduces the amount of contact between the media and the sensor.

Fluid Column Height In PSI

Height of tank in feet / 2.31 X Specific Gravity of the fluid = PSI

The formula above is an aid for proper sensor sizing when looking for a media column height.

The formula above can also work to use the pressure sensor to read the volume of a tank. With the formula below you can use the height, width and depth of a tank to get the volume.

There are 231 cubic inches (0.133681 cubic feet) in one US liquid gallon (*Fig. 4*).

NOTE: *water specific gravity = 1*

Fig. 4

FORMULAS

Pressure Sensor Sizing
16 FT/2.31 · 1 = PSI
16 FT/2.31 · 1 = 6.93 PSI
15 PSIG sensor is chosen
PT15PSIG-1003-I2-H1143

Using Pressure To Detect Volume
$(3.14 \times r^2) \times$ height of tank
$(3.14 \times 3\ FT^2) \times 16\ FT = 4071.5\ FT^2$
$452.4\ FT^2/0.133681 = 3384$ Gallons (full tank)
$(3.14 \times 3\ FT^2) \times 12\ FT = 339.4\ FT^2$
$339.4\ FT^2/0.133681 = 2538.9$ Gallons
(with 12 FT water column height)

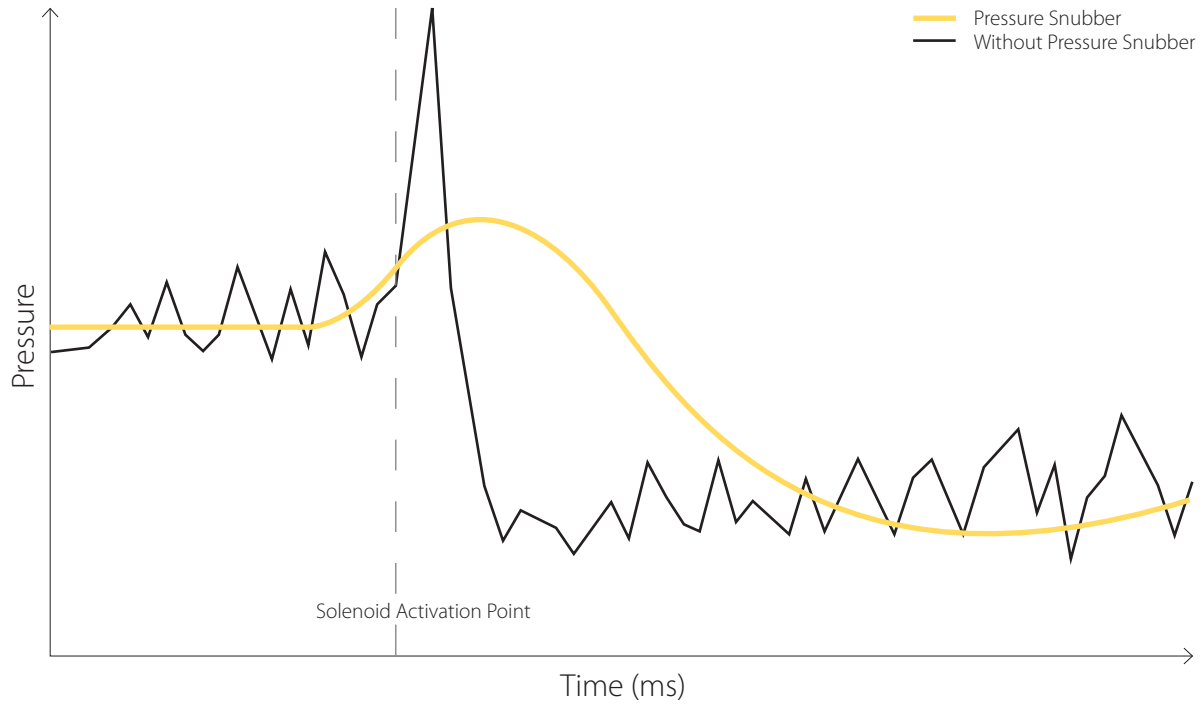


Fig. 5

Over Pressure And Burst Pressure

Each measuring cell is designed for a specific measuring range. This determines the thickness of the measuring cell. When a measuring cell is pressurized over its rated pressure range, it can cause zero/span shifts or damage to the cell. There are two specifications given to this:

Permissible Overpressure is the amount of pressure over the range that may cause the sensors zero/span point to shift, but will not cause the cell to burst.

Burst Pressure is typically greater than the over pressure and is the maximum pressure the cell can handle before the cell bursts or ruptures. Once the cell ruptures, you may see the media leaking from the sensors reference vent.

*Pressure Spikes And Transients

Pressure sensors will undoubtedly be subject to pressure spikes or transients during operation. This generally occurs when a positive displacement pump is energized with no soft start, or when a valve is opened and closed quickly (i.e., a solenoid valve). Water hammer is also a very common cause of pressure spikes. Below we have highlighted some common ways to lessen the effects of pressure spikes or transients (*Fig. 5*).

Pressure Snubber is a process fitting that would go onto the process connection of the pressure sensor and is either a sintered metal/ceramic screen or an orifice. This helps to control the amount of volume that can be moved to the pressure cell and isolates the spike before the pressure cell.

Pulsation Dampener is a device that goes on the process line that the sensor is connected to. This works by having a pressurized air gap that is sealed from the process media by a membrane. The air gap will act as a shock absorber for the pressure cell.

Pulsation Hose is a pressure rated hose that is made to flex with pressure spikes to help relieve some of the stress the sensor would see. These can either be placed in between the sensor and the process pipe or can be mounted on the process line that the pressure sensor is mounted to.

Calibration NIST Certificates

Pressure sensors do not generally come with a calibration certificate, although it is possible to receive a certificate when ordering any pressure sensor from Turck. If a /S1802 is added to the end of a pressure sensor part number (i.e., PT30PSIG-2003-I2-H1141/S1802) this sensor will come with a 5 point NIST traceable calibration certificate. This certificate tells you the deviation and consistency of the transmitters output from the factory. The calibration certificates are compliant to the old Z540 standard as well as the newer Z540.3. It will be up to the purchaser to determine the calibration intervals and to find a calibration facility to keep the sensors certificate up to date.

**High Temperature Applications

Using a sensor in applications where the media temperature is higher than the sensor rating may cause sensor failure or a decrease in sensor performance. This is not recommended. Below are some common ways to mitigate the amount of heat transferred by the media (*Fig.6*).

Siphon Tube is a tube that is generally bent in a 180° or 360° rotation. This works by not allowing fresh heated fluid to move through the pipe, creating a cool spot.

Stand Pipe is a length of pipe used as an insulation barrier. The longer the pipe the more heat is lost through the stand pipe and does not reach the sensor.

Auxiliary Hose goes between the sensor and the process pipe much like a stand pipe would, only it is a pliable hose that will have to be rigidly mounted.

Heat Exchanger is a device that generally has heat sink fins on it. The fins help wick away the heat in the heat exchanger to the ambient air.

Diaphragms are generally not used as a way to protect the sensor from heat, and due to not having heat dissipation charts the overall effectiveness is unknown. Diaphragms are large pieces of metal that provide a barrier between the sensor and media and will help mitigate some of the heat that would be seen by the sensor.

PCS - G 1/4A4 Heat Exchanger

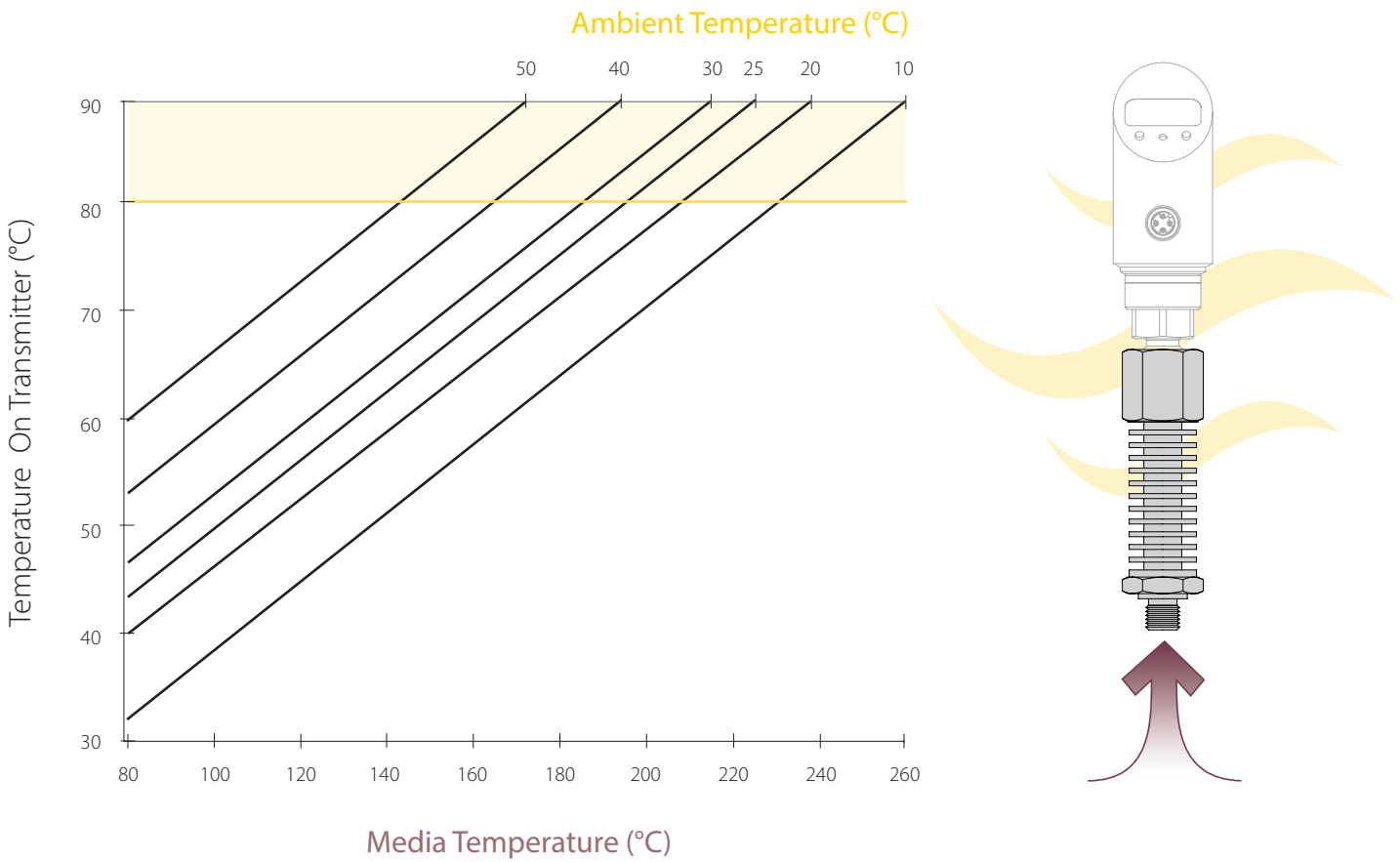


Fig. 6

Process Connections

The process side of the sensor is the area in which the media comes in contact with the measuring cell. This is where the connection is made from the system to the transmitter. There are many ways to make this connection. The most common are threaded connections, and below are common types of threaded connections used. For non-threaded connections, see the diaphragm sections for alternatives.

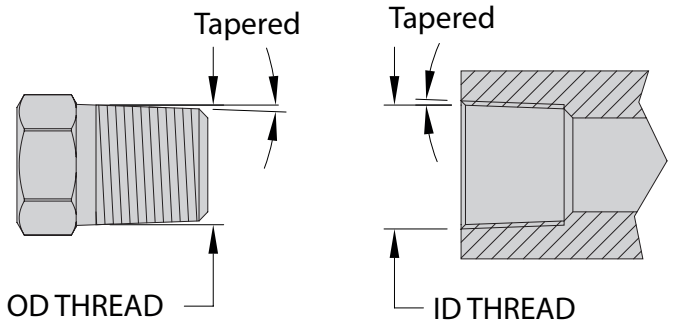


Fig. 7

National Pipe Taper (NPT) is the most common thread used in the US. There are different types of NPT threads, but all are tapered for sealing, while some require the use of a thread sealant. Others, such as NPTF, are a dry seal taper thread that seals by deforming the threads (*Fig. 7*).

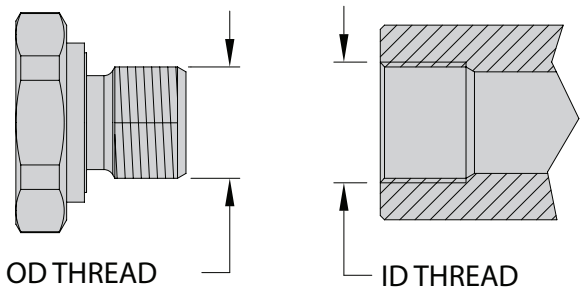


Fig. 8

British Standard Pipe Parallel (BSPP or G) is a common thread in Europe. This is a straight thread that is sealed by the use of a gasket or O-ring (*Fig. 8*).

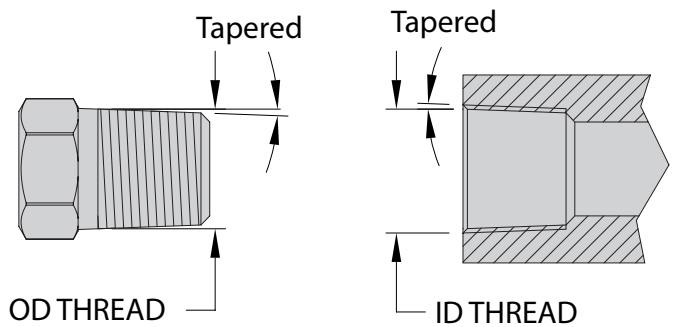


Fig. 9

British Standard Pipe Tapered (BSPT or R) is a common thread in Europe. This is a tapered thread like NPT but the pitch is different. The threaded diameter is close but not identical and not interchangeable. The seal is formed by deforming the threads much like NPTF (*Fig. 9*).

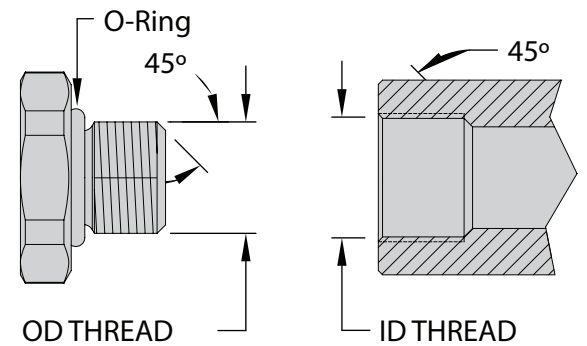


Fig. 10

Society of Automotive Engineers O-ring Boss (SAE ORB) is used in high pressure hydraulic systems. It has a straight thread that is sealed by compressing an O-ring on the male thread to a chamber on the female thread that guides the O-ring and applies the correct compression (*Fig. 10*).

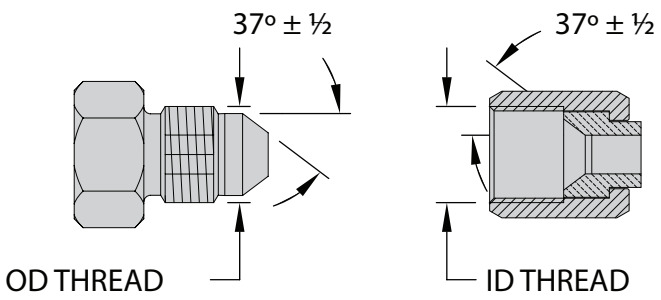


Fig. 11

Joint Industrial Commission (JIC) 37° Flare is a very common fluid power connection. The male half has a flare and the female half has a cone, both with a 37° seat. The seal is established by the flare and cone compressing together (*Fig. 11*).

Glossary Of Terms

Term	Definition
3A	3A is an independent, not-for-profit corporation dedicated to advancing hygienic equipment design for the food, beverage, and pharmaceutical industries.
4 - 20 mA Loop	In industrial process control, analog 4 - 20 mA current loops are commonly used for electronic signaling, with the two values of 4 & 20 mA representing 0 - 100% of the range of measurement or control.
Absolute Pressure	Absolute pressure is zero-referenced against a perfect vacuum, so it is equal to gauge pressure plus atmospheric pressure. Negative signs are usually omitted.
Accuracy	The maximum deviation from the theoretical linear line between a sensor's zero and span output seen by the characteristic curve observed in testing under specified conditions and by a specified procedure. Accuracy must include Hysteresis, Non-Repeatability, and Non-Linearity.
Ambient Conditions	Typically include temperature, humidity, and air pressure.
Atmospheric Pressure	The amount of pressure produced by the weight of the atmosphere. This can change relative to elevation from sea level as well as shifts in barometric pressure.
Auxiliary Hose	A pliable hose that goes in between the sensor and process pipe an insulator and a place for the heat to dissipate.
Bar	A metric unit of pressure. It is defined as exactly equal to 100,000 Pa, which is slightly less than the current average atmospheric pressure on Earth at sea level.
Barometric Pressure	See ***Atmospheric Pressure***.
Best Fit Straight Line (BSFL)	The relationship of the plotted characteristics of the pressure cell and a calculated straight line that does not pass through the end points. The linear line is placed in the center of the accuracy deviation to minimize error.
British Standard Pipe Parallel (BSPP or G)	A common thread in Europe. This is a straight thread that is sealed by the use of a gasket or O-ring.
British Standard Pipe Tapered (BSPT or R)	A common thread in Europe. This is a tapered thread like NPT but the pitch is different. The threaded diameter is close but not identical and not interchangeable. The seal is formed by deforming the threads much like NPTF.
Burst Pressure	Typically greater than the over pressure and is the maximum pressure the cell can handle before the cell burst or ruptures. Once the cell ruptures, you may see the media leaking from the sensors reference vent.

Capillary Tube	See ***Auxiliary Hose***.
Clean In Place (CIP)	A method of cleaning the interior surfaces of pipes, vessels, process equipment, filters, and associated fittings, without disassembly. Commonly used in food and pharmaceutical processes.
Compensated Range	The temperature range in which the accuracy holds true without any added deviations.
Compound Pressure	A measurement of both positive and negative (vacuum) pressures.
Diaphragm Seal	A device that is placed on the process side of the sensor that can be made of different materials to allow for greater chemical compatibility. Also called an isolator.
Differential Pressure	A sensor that uses two measurement cells; one for high pressure and one for low pressure, and calculates the difference between them.
Dynamic Pressure	Continually changing pressure, or a pressure that may not be stable or subject to change under normal operation.
Full Scale (FS)	The relationship of the plotted characteristics of the pressure cell and a calculated straight line that starts and stops at the cell's end points. The greatest deviation away from the linear line would be the accuracy deviation.
"G" Process Connection	See ***British Standard Pipe Parallel (BSPP or G)***.
Gauge Pressure	Gauge pressure is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure.
Head Pressure	Is the pressure caused by the weight of the fluid on a specific area.
Heat Exchanger	A device for transferring heat from one medium to another.
Hydrophobic	A material that will repel the mass of water.
Hysteresis	The maximum difference in sensor output at a pressure when that pressure is first approached with pressure increasing, and then approached with pressure decreasing during a full span pressure cycle.

Term	Definition
kPa	Kilopascal, or 1,000 newtons per square meter.
JIC	A very common fluid power connection. The male half has a flare and the female half has a cone, both with a 37° seat. The seal is established by the flare and cone compressing together.
LHR	Linearity, Hysteresis, and Repeatability; a common call-out for accuracy.
Linearity	Where inconsistency comes in. There are two methods typically used: ***Best Fit Straight Line (BFSL)***, and ***Full Scale (FS)*** or Terminal Point. It is the amount of error that exists between a sensor output and a linear line.
Long Term Stability	The degree of uniformity over time. Environmental conditions can change such as supply voltage load and temperature.
mPa	Mega Pascal, equal to one newton per square meter.
NIST Certificate	A third party certificate of calibration. Done to the standards of the National Institute of Standards and Technology.
National Pipe Taper (NPT)	The most common thread used in the US. There are different types of NPT threads, but all are tapered for sealing. Some require the use of a thread sealant.
O-ring Face Seal (ORFD)	This connection offers very good leak control due to the O-ring seating on a flat surface. The male portion has straight threads with an O-ring on the face of the connection, while the female portion has a large flat spot for the O-ring to seat.
Oxygen Clean	The verifiable absence of particulate, fiber, oil, grease, and other contaminants.
Permissible Overpressure	The amount of pressure over the range that may cause the sensors zero/span point to shift but will not cause the cell to burst.
PG	Abbreviation for PSIG.
Pressure Sensor	Can work as either as a pressure transmitter/transducer and/or a pressure switch.
Pressure Snubbers	A process fitting that would go onto the process connection of the pressure sensor and is either a sintered metal/ceramic screen or an orifice. This helps to control the amount of volume that can be moved to the pressure cell and isolated the spike before the pressure cell.

Pressure Spike, or Transient	Refers to any pressure wave that is short lived (i.e., not static pressure or pressure differential due to friction/minor loss in flow). The most common occurrence of this is called water hammer.
Pressure Switch	Converts mechanical force of gases or liquids to an electrical signal. The electrical signal is discrete. Normally open or closed contact that switches state when the pressure rises above or falls below the set point.
Pressure Transmitter / Pressure Transducer	Converts mechanical force of gases or liquids to an electrical signal. The electrical signal is an analog current or voltage of a specified value.
Process Connections	The process side of the sensor is the area in which the media comes in contact with the measuring cell. This is where the connection is made from the system to the transmitter.
Proof Pressure	See ***Permissible Overpressure***.
PSIA	Unit of measure; Pounds per Square Inch, with a reference of Absolute pressure.
PSIG	Unit of measure; Pounds per Square Inch, with a reference of Gauge pressure.
PSIS	Unit of measure; Pounds per Square Inch, with a reference of Sealed pressure.
PSIV	Unit of measure; Pounds per Square Inch, with a reference of Gauge pressure and a compound range.
Pulsation Dampener	A device that goes on the process line that the sensor is connected to. This works by having a pressurized air gap that is sealed from the process media by a membrane. The air gap will act as a shock absorber for the pressure cell.
"R" Process Connection	See ***British Standard Pipe Tapered (BSPT or R)***.
Ratiometric	An output voltage that is a ratio of 10 - 90% of the supply voltage (i.e., 5 VDC regulated supply 0.5 - 4.5 VDC output).
Relative Pressure	The pressure caused by the weight of air in the atmosphere.
Repeatability	The maximum difference in output when the same pressure is applied, consecutively, under the same conditions and approaching from the same direction.

Term	Definition
Resolution	The smallest unit that can be reliably measured, considering accuracy.
Response Time	How fast the output changes with the mechanical pressure change in the system.
SAE-ORB	Used in high pressure hydraulic systems. It has a straight thread that is sealed by compressing an O-ring on the male thread to a chamber on the female thread that guides the O-ring and applies the correct compression.
Sealed Pressure	The reference of the pressure sensor is sealed when manufactured. This may induce a small error when used in different elevation from where it was manufactured.
Siphon Tube	This is a tube that is generally bent in a 180° or 360° rotation. This works by not allowing fresh heated fluid to move through the pipe creating a cool spot.
Span	The distance from the zero point to the end point.
Span Shift	The deviation of the analog end point.
Stand Pipe	This is a length of pipe used as an insulation barrier. The longer the pipe the more heat is lost through the stand pipe and does not reach the sensor.
Static Pressure	The pressure of a fluid on a body when the body is at rest relative to the fluid.
Thermal Shift	The deviation of the zero/end points that are caused by temperature shifts.
Total Error Band	Accounts for accuracy, sensor stability, thermal effect on zero/span, and zero/span shift. This will take into account all of the potential errors that may be induced on the sensor.
Water Column (W.C.)	The amount of pressure produced by a column of liquid.
Water Hammer	A pressure surge or wave caused when a fluid (usually a liquid but sometimes a gas) in motion is forced to stop or change direction suddenly.
Wetted Materials	The materials that come into contact with the media.
Zero Shift	A deviation of the zero point.

Notes

Notes

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For Application Assistance or for the location of your nearest Turck distributor, call:

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